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**SYSTEMATIC STUDIES ON THE GENUS PALAEORHIZA OF NEW GUINEA
COLLECTED BY THE THIRD ARCHBOLD EXPEDITION (I)
(HYMENOPTERA, COLLETIDAE)***

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Abstract

The bee genus ***Palaeorhiza*** of New Guinea collected by the 3rd Archbold Expedition was studied. Twenty-five species divided into 12 subgenera are reported for the 1st report. New taxa described in this paper are: *Michenerapis*, new subgenus; ***Palaeorhiza*** (*Michenerapis*) *bicolor*, ***P.*** (*Sphecodaster*) *rufescens*, ***P.*** (*Heterorhiza*) *amabilis*, ***P.*** (*Heterorhiza*) *misoolensis*, ***P.*** (*Heterorhiza*) *grandis*, ***P.*** (*Heterorhiza*) *moluccensis*, ***P.*** (*Anchirhiza*) *affinis*, ***P.*** (*Palaeorhiza*) *nitens*, ***P.*** (*Zarhiopalea*) *facialis*, ***P.*** (*Eupalaeorhiza*) *melina*, ***P.*** (*Cnemidorrhiza*) *flavescens*, ***P.*** (*Cnemidorrhiza*) *aemula*, ***P.*** (*Cnemidorrhiza*) *decorata*, ***P.*** (*Cercorrhiza*) *simillima*, ***P.*** (*Cercorrhiza*) *pullata* and ***P.*** (*Cercorrhiza*) *angusta*, new species; and ***P.*** (*Ceratorrhiza*) *conica rufa*, ***P.*** (*Zarhiopalea*) *facialis basirufa*, ***P.*** (*Eupalaeorhiza*) *papuana insularis*, ***P.*** (*Hadrorrhiza*) *lieftincki mutata*, and ***P.*** (*Cercorrhiza*) *gressittorum rubicunda*, new subspecies. *Eupalaeorhiza* is regarded as a good subgenus. ***P.*** (*Heterorhiza*) *enixa* Cheesman is treated as a new synonym of ***P.*** (*Heterorhiza*) *lusoria* (Smith).

This paper reports a first half of the results of our systematic studies on the bee genus *Palaeorhiza* Perkins of New Guinea collected by the 3rd Archbold Expedition. Some specimens of *Palaeorhiza* which came from another source are also included. Twenty-five species which are divided into 12 subgenera are reported in this paper. It includes the descriptions of 1 new subgenus, 16 new species and 5 new subspecies as well as 1 new synonym. Biological observations on three species, ***P.*** (*Paraheterorhiza*) *hilara* Cheesman, ***P.*** (*Eupalaeorhiza*) *papuana* (Meade - Waldo) and ***P.*** (*Cnemidorrhiza*) *flavescens*, new species, made by Lieftinck are also noted.

* Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 3, No. 116).

The collecting stations of the 3rd Archbold Expedition to New Guinea 1938'39 were listed by Toxopeus (1940). The present materials were taken at 12 stations, as follows :

Hollandia, coast of Humboldt Bay, near the frontier of the Mandated Territory. Collections made in open grassy areas, in virgin and in secondary jungle on limestone, and in a river bed on the outskirts of the Cycloop Mts. (old formation). *Altitude* : 0-100 m. *Time*: June 17-July 28, 1938 (dry season) and April 16-20, 1939 (end of rainy season).

Lake Habbema, \pm 15 km N. of Mt. Wilhelmina. Moorland, fens and sparse coniferous forest, furthermore the highest outposts of the high mountain moss forest. *Altitudes* : surface of Lake at 3225 m, surrounding hills to 3400 m; most of materials gathered at 3250m. *Time*: dry season, June 29-July 29, 1938, some specimens in the beginning of the rainy season, chiefly by Sundanese collectors (mantri's) from Java, during September.

Letterbox Camp, \pm 4 km E. of Mt. Wilhelmina. Swampy alpine vegetation, at the timber line. *Altitudes*: 3560 m, and 3700m. *Time*: Aug. 30-Sept. 13, 1938, further by Sundanese collectors during remainder of September.

Moss Forest Camp, in high jungle at good 5 km N. E. from Lake Habbema. High mountain moss forest, of mainly *Nothofagus* trees, few conifers, thick undergrowth of orchids and ferns. At a hundred meters lower down local change into richer vegetation without thick moss, due to sheltered position. *Altitude*: 2800 m. Some further collecting was done at 3000 m, at a small plateau with bogs and conifers, recalling the Lake Habbema surroundings; at 2700m in the rich rainy forest, and at 2600m in a deep ravine with much insect life owing to its open condition. *Time* : Preliminary excursion Aug. 22-24, 1938, in the dry season; afterwards a stay from Oct. 8-Nov. 6, 1938, in the rains.

Ibèlè Camp, at the borders of Papuan cultivated grounds, situated on the steep banks of Ibèlè R., about 8km N. E. of the former camp. *Altitude*: 2250 m, collections from 2300-2150 m. *Time*: Preliminary excursion Aug. 23, 1938, in the dry season, main stay from Nov. 6-Dec. 5, interrupted by a patrol to Baliem Valley from Nov. 11-25, during which the mantri's continued collecting at the Ibèlè R.

Baliem R., at the S. extremity of the grand valley, amidst the cultivations of the Papuas, three days' march away from the above-named camp, at \pm 30 km E. of Lake Habbema. No primeval forests, many grass-covered hills. *Altitude* : 1600 m. *Time*: First excursions Nov. 15-22, 1938, then collections made by the assistant to Dec. 7, finally by all collectors up to Dec. 18. Although rainy season prevailed, during day time the weather was fine, but cloudy, while the rains came down at night.

Mist Camp, on the mountain ridge S. of Bernhard Camp on the Idenburg R. Dense, very damp forest in a saddle. *Altitude*: 1800 m. *Time*: Dec. 25,

1938-Jan 6, 1939 by the assistant and mantri's, then till Jan. 19 by all collectors. Rainy season, nearly no sunshine but constantly fog and rain.

Top Camp, an outpost of Mist Camp, situated on a sparsely overgrown summit, less cloudy. *Altitude*: amply 2100 m. *Time*: Jan. 20-25, 1939, thereafter the mantri's to Febr. 10.

Lower Mist Camp, below the fog zone in a sheltered ravine, which came out into the head-waters of the Sahuweri R. *Altitude*: 1560 m, but collections were made from 1400-1700 m. *Time*: Jan. 26-Febr. 2, 1939.

Sigi Camp, situated in the swampy Sigi River Valley, more open and more exposed to the sun than Rattan Camp (in a dense jungle with many rattan-palms, on a ridge sloping into the Araucaria-River, 1200 m, Febr. 3-14). *Altitude*: 1500 m, but collecting was done between 1300 and 1600 m. *Time*: Febr. 15-28, 1939.

Araucaria Camp, in the basin of the Araucaria R., little more than one hour's walk down from the former camp site. Rain forest, many palms and wild sugar cane on the beach. *Altitude*: good 800 m; collections from 700-900 m. *Time*: March 1-April 4, 1939. Rainy and often stormy.

Bernhard Camp, on a dead arm of the Idenburg R., about 10 m above the river bed in dry season, but flooded in the height of the west monsoon. Dense virgin jungle, locally swampy, traversed by many creeks. *Altitude*: ±50 m; collections were made up to the mountain foot. *Time*: 1st. in the dry season, by the assistant and Sundanese collectors, from July 15-Nov. 15, 1938 (the last month, however, in the turn of the season). 2nd. in the rainy season; Dec. 19-24, 1938, Febr. 8-11 and April 11-14, 1939.

All the types of new species and subspecies described in this paper will be deposited in the collection of the Rijksmuseum van Natuurlijke Historie, Leidkn; the rest of the specimens will be deposited in the latter institution and American Museum of Natural History, New York.

We are grateful to the authority of the Department of Entomology, British Museum (Nat. Hist.), London and to Mr. George R. Else, Curator of Bees of the said institution for the loan of the type specimen of *Eupalaearhiza papuana* Meade-Waldo for the present study. We are also grateful to Prof. Charles D. Michener, Department of Entomology, University of Kansas, Lawrence, Kansas, U. S. A. for his valuable comment on *Michenerapis*, new subgenus.

KEY TO SUBGENERA OF *Palaearhiza* TREATED IN THIS PAPER

1. Preoccipital carina absent; space between clypeus and compound eye very narrow, narrower than width of mid ocellus; posterior spur of male hind tibia strongly modified *Michenerapis*, new subgenus
- Preoccipital carina present; space between clypeus and compound eye distinct, at least about as broad as mid ocellus; posterior spur of male hind tibia slender and simple as usual

2. Propodeal enclosure strongly convex in the middle or with a conical projection 3

- Propodeal enclosure not convex in the middle 4

3. Propodeal enclosure distinctly convex in the middle; 1st tergum small with basal portion distinctly constricted and subpetiolate; large, more or less slender and non-metallic species ***Sphécogaster***

- Propodeal enclosure with a conical projection; posterior spur of female hind tibia serrate; large and robust species, with head and thorax black (with yellow markings) and metasoma blue-green ***Ceratohiza***

4. Propodeal enclosure longitudinally densely fluted 5

- Propodeal enclosure not fluted 6

5. Integuments of head and thorax strongly sclerotized, with very dense, usually strong punctures on the latter; posterior spur of female hind tibia distinctly serrate; male 7th tergum with a pair of long spines at apex which are broadly separated from each other; male mandible simple at apex ***Heterorhiza***

- Integuments of head and thorax appearing softer; posterior spur of female hind tibia simple; male 7th tergum with or without a pair of projections which are not broadly separated when present; male mandible bidentate ***Paraheterorhiza***

6. Female mandible very large and edentate; scutellum, metanotum and most part of propodeal enclosure flat; male 2nd flagellar segment (in *mandibularis*) distinctly longer than broad ***Anchirhiza***

- Female mandible as usual; scutellum, metanotum and most part of propodeal enclosure convex as usual; male 2nd flagellar segment at most as long as broad 7

7. Dorsal face of propodeum with a pair of small swellings apically close to enclosure; the latter either depressed apically or densely and finely shagreened and dull 8

- Propodeum without such swelling dorso-apically 9

8. Propodeal enclosure longitudinally depressed in the middle apically, smooth, shining; upper portion of supraclypeal area and median portion of frons longitudinally elevated (broad longitudinal yellow stripe on this portion); posterior spur of female hind tibia serrate ***Palaeorhiza s. str.***

- Propodeal enclosure densely and finely shagreened and dull, often transversely slightly concave; swelling of upper portion of supraclypeal area sharply defined from flat frons (no yellow stripe on frons); posterior spur of female hind tibia normal ***Zarhiopalea***

9. Glossa of male very long; male 5th sternum concealed by the preceding sternum; male 6th sternum strongly convex in the middle; non-metallic species; posterior part of thorax, basal part of metasoma and legs honey-colored; propodeal enclosure somewhat coarsely sculptured in the middle ***Eupalaeorhiza***

- Glossa of male much shorter; male 5th sternum exposed as usual; usually metallic, not honey-colored species 10

10. Large, robust, strongly metallic species; propodeal enclosure punctate-roughened at least on apical portion, usually well convex basally; posterior spur of female hind tibia finely serrate ***Hadrorhiza***

- Propodeal enclosure not punctate-roughened; posterior spur of female hind tibia simple 11

11. Female hind tibia thick, dorsal face usually broad and punctate-roughened or coarsely sculptured basally; female hind femur with a tuft of black hairs at apex (sometimes obscure); female 6th tergum with a caudal fimbria of dense downy hairs in the middle ***Cnemidorrhiza***

- Basitibial plate present in female ; female 6th tergum with a pygidial plate and a caudal fimbria **Cercorhiza**

(I) Subgenus ***Michenerapis***, new subgenus

Type-species : *Palaeorhiza (Michenerapis) bicolor*, new species

The new subgenus is unique in respect that the preoccipital carina is absent. By this character, it is easily separable from any subgenus of *Palaeorhiza*, and may be regarded as distinct at the genus level. Unfortunately this is known from the male of the type-species only.

The new subgenus is characterized as follows:

Non-metallic (black and red), medium-sized, rather robust species; head and thorax with long, dense black hairs.

Preoccipital carina absent; glossa pointed, shorter than mandible, which is bidentate at apex; clypeus very broad, rather short; space between clypeus and eye very narrow; 1st segment of flagellum elongate, about twice as long as broad; propodeal enclosure almost all dorsal (finely lineolate and shining as usual), with a longitudinal median line on more than apical half; hind femur somewhat swollen; hind tarsus shorter than usual, about as long as hind tibia; hind tibia with posterior spur unusually strongly modified, anterior spur also short and thick; genitalia broad with penis valves distinctly exceeding apex of gonostyli.

It is with great pleasure that we name this new taxon in honor of Prof. Charles D. Michener of the University of Kansas whose contribution toward the knowledge of bees is of incalculable value.

(1) ***Palaeorhiza (Michenerapis) bicolor***, new species

Male: Length about 10 mm.

Relative head measurements : width, 44.0; length, 35.0; upper interocular distance, 22.0; width of face, 25.5; lower interocular distance, 15.0 ; eye length, 29.0; length of clypeus, 15.0, that of clypeus below line tangential to lower margins of eyes, about 3.5. Eyes very large, with inner margins strongly converging below except upper one-fourth which converges toward ocelli; malar space very narrow, about equal to space between eye and clypeus; clypeus unusually large for *Palaeorhiza*, upper portion flat, lower portion slightly convex ; clypeus and supraclypeal area scarcely convex when the head is seen from side; median portion of frons and upper portion of supraclypeal area weakly longitudinally convex ; ratio of width of posterior ocellus to post-ocellar distance to ocellocular distance to ocelloccipital distance as 3.5 : 3.0 : 6.0 : 5.0; space behind ocelli rather flat. Antennae long; scape slightly shorter than mandible, about equal to 3 basal segments of flagellum together ; flagellum with 1st segment slightly longer than 3rd, 2nd about as long as broad. Thorax not strongly convex dorsally as seen from side; precoxal



Fig. 1. *Palaeorhiza (Michenerapis) bicolor*, new species. Frontal view of the head.

carina more or less strong; underside of thorax longitudinally slightly concave. Wings with stigma small ; 2nd submarginal cell about three-fifths as long as 1st along lower margin (about 20: 13), 1st abscissa of vein M short, as long as 3rd abscissa; nervulus distinctly basad of vein M. Legs with tibial spurs shorter and darker (brown) than usual ; *posterior spur of hind tibia thick, strongly convex ventrally in the middle*, sharp and pointed at apex as usual. Metasoma with 1st tergum rather long, well convex dorso-basally; 2nd tergum moderately convex medially, distinctly constricted basally; 7th tergum with apical margin broad, rounded laterally, with long black hairs as usual; 3rd sternum with a pair of weak, longitudinal (converging posteriorly) ridges sublaterally.

Clypeus strongly rugoso-punctate (this is unusual for the male of *Palaeorhiza*) on minutely roughened and weakly shining ground, with an indication of impunctate longitudinal line above medially; lower portion of supraclypeal area with sculpturing similar to upper portion of clypeus ; upper portion of supraclypeal area, frons, face lateral to frons densely longitudinally rugoso-punctate (this is also unusual for *Palaeorhiza*). Mesoscutum with more or less strong, rather sparse punctures (but irregular in distribution) on nearly smooth and shining ground; scutellum similarly sculptured to mesoscutum but punctures slightly weaker ; propodeum densely and distinctly punctate except enclosure ; sides of thorax shining ; mesepisternum strongly, densely and longitudinally rugoso-punctate. Metasoma smooth, shining, 1st tergum with weak and sparse punctures, apical portion broadly impunctate ; 2nd and 3rd similar to 1st; 4th somewhat distinctly punctate on microscopically tessellate, still shining ground, with apical impunctate margin linear.

Head black including mandibles and antennae except for flagellum beneath reddish; evanescent line along lower inner margin of eye yellowish; head weakly shining but frons nearly dull. Thorax black, more shining than head. Wings brownish, with hairs, stigma and veins fuscous; tegulae piceous, rather shining. Legs black or piceous, with tarsi partly reddened, and base of fore tibia and apex of fore femur with pale yellow mark anteriorly; tibial spurs brown or darker. Metasoma orange red except for about basal half of 1st

PALAEORHIZA COLLECTED BY THE THIRD ARCHBOLD EXPEDITION

tergum and 1st sternum reddish brown, shining.

Hairs on head long, rather dense, black, even on face. Hairs on thorax like head, slightly paler on propodeum and underside. Hairs on legs mostly blackish; fore femur with long, rather dense, blackish hairs behind (this is unusual for *Palaeorhiza*); similar blackish hairs (but slightly shorter) on fore tibia and fore basitarsus behind. Metasoma not hairy like head and thorax; 1st tergum with whitish hairs on basal declivity; 6th tergum with a row of long black hairs subapically; 5th sternum with a row of decumbent golden hairs on apical margin.

TYPE MATERIAL: Holotype male, Moss Forest Camp, 2700 m, 15. X. -5. XI. 1938 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(II) Subgenus **Sphecogaster** Hirashima

Hirashima, 1978 b, p. 72.

Type-species: *Palaeorhiza paradisea* Hirashima, 1978

The subgenus was proposed for two New Guinean species, *P. paradisea* Hirashima and *P. pernigra* Hirashima. It is unique in having the 1st metasomal tergum small and subpetiolate at the base in addition to a distinct swelling on the propodeal enclosure. The species of this subgenus are large but more or less slender. Here we report the third species, which is unique in having the thorax red.

KEY TO THE SPECIES OF *Sphecogaster*

1. Entirely black species ; hairs on body including legs white (even hairs on apex of metasoma) ; wings hyaline ; male unknown **pernigra**
- Not entirely black species ; hairs on apex of metasoma blackish ; wings brownish 2
2. Head, thorax and metasoma black; the latter with slight metallic tint; legs yellow ; swelling on upper portion of supraclypeal area very conspicuous, dilated laterally **paradisea**
- Head and metasoma black; the latter with slight metallic tint; thorax red with pronotum and most part of propodeum black ; legs piceous; swelling of upper portion of supraclypeal area low **rufescens**, new species

(2) ***Palaeorhiza (Sphecogaster) rufescens*, new species**

Female : Length 10.5-11.5 mm, rather slender.

Relative head measurements: length, 42.5 (apical margin of clypeus slightly emarginate in the middle) ; width, 44.5; upper interocular distance, 22; width of face, 27 ; lower interocular distance, 19.8; eye length, 34; length of clypeus, 19 (the upper margin of clypeus very feebly indicated in this species), that of clypeus below line tangential to lower margins of eyes, about 7. Inner eye margins more converging below than in *paradisea* and *pernigra*;

mandible tridentate as usual for the subgenus; malar space distinct but shorter than basal width of mandible (about 4.5 : 6); clypeus broadly flat; supraclypeal area moderately convex (slightly lower than in *pernigra*, much lower than in *paradisea*), dilated laterally with rather sharp edges; ocelli rather large, close together like *paradisea* and *pernigra*; space behind ocelli slightly concave. Propodeal enclosure convex as in *pernigra*; precoxal carina conspicuous. Wings long with large 2nd submarginal cell as usual for the subgenus. Fore tarsus with polliniferous hairs not specially well developed like *paradisea* and *pernigra*. Metasoma as described for the subgenus.

Mesoscutum strongly and densely rugoso-punctate, punctures slightly stronger than in *paradisea* and denser than in *pernigra*; propodeal enclosure minutely roughened (tessellate or shagreened) and dull as usual for the subgenus; pre-episternum and upper portion of mesepisternum with punctures much weaker than those on mesoscutum like *paradisea* and *pernigra*, but these portions smoother and more shining than in these species; underside of thorax also not coarsely sculptured, shining; metasoma with sparse punctures which are not stronger than in *paradisea*; impunctate apical margins of four basal terga broad and well marked as in *paradisea* and *pernigra*.

Head shining black, including mandibles; thorax red, shining, but most part of pronotum and propodeum black; propodeal enclosure variable, entirely red to entirely black. Wings distinctly brownish, more darkened distally; veins and stigma brown; tegulae and veins close to the latter ferruginous subhyaline. Legs piceous, shining. Metasoma black, partly piceous, shining, with very slight metallic (purple and blue) tint.

Head with hairs silvery on vertex and genal area, scanty or almost bare in front; thorax with hairs silvery; metasoma with hairs silvery except for blackish hairs on three apical terga and on 6th sternum; 1st tergum with white hair fringe on lateral portion of apical margin.

Male: Similar to female but differs as follows :

Relative head measurements : length, 40; width, 38.5; upper interocular distance, 18; width of face, 22; lower interocular distance, 14; eye length, 30; length of clypeus, 18, that of clypeus below line tangential to lower margins of eyes, about 8.5. Head rather small for the size of insect; face narrower and inner margins of eyes more converging below; eyes rather large; mandible distinctly bidentate; malar space as long as basal width of mandible (slightly longer than in *paradisea*); clypeus flat with upper portion concave (best seen in side view of the head); scape rather long, slightly shorter than lower interocular distance; flagellum long, with 1st segment longer than broad, about as long as 3rd, 2nd broader than long. Head with following marks ivory : somewhat triangular large mark on clypeus, narrow stripe on face lateral to median portion of clypeus, spot on labrum and stripe on mandible; the latter absent in one out of four specimens; metasoma more strongly

purple and blue, or deep brownish red with strong purple tint; fore tibiae dull yellow anteriorly.

TYPE MATERIAL : Holotype female, Ibèlè Camp, 2250 m, 27. XI. 1938 (L. J. Toxopeus) ; 8 paratopotype females and 4 paratopotype males, 25-30. XI. 1938 (L. J. Toxopeus) ; 3 paratype females, Top Camp, 2100 m, I-II. 1939 (L. J. Toxopeus) .

DISTRIBUTION : W. New Guinea.

(III) Subgenus **Ceratorhiza** Hirashima

Hirashima, 1978 b, p. 81.

Type-species: ***Palaeorhiza conica*** Michener, 1965

The subgenus was proposed for two New Guinean species, *P. conica* Michener and *P. rubrifrons* Hirashima. It is unique in having a conical projection on the propodeal enclosure. For the further characters of importance see Hirashima (1978 b). Here we report a new subspecies of *P. conica* Michener, which might be regarded as a distinct species when more materials are examined.

(3) ***Palaeorhiza (Ceratorhiza) conica rufa*, new subspecies**

Metanotum densely covered with short to long fulvous hairs (hairs brownish to brown in *conica conica*) ; metanotum yellow in the middle in 1 female, obscurely so in 1 female and narrowly yellow in the middle behind (next to scutellum) in 1 male specimens (metanotum black in c. *conica*) ; female 1st tergum red with fulvous or yellowish hairs (metallic blue-green and purple with brownish hairs in c. *conica*) ; male 1st tergum metallic blue-green as in c. *conica* but piceous basally; hairs on basal terga of female appearing fulvous in some light (brown or nearly so in c. *conica*) ; hairs on face including clypeus longer, especially so in male ; female mandible very weakly notched below, therefore appearing weakly bidentate (simple in c. *conica*) ; inner margins of eyes of male more emarginate than in c. *conica*; this is indicated by the following relative measurements of head (for c. *conica* (a male of similar size) in parentheses) : length, 47 (46) ; width, 49 (46.5) ; upper interocular distance, 25.5 (24.5) ; width of face, 30 (28) ; lower interocular distance, 24 (23).

Male genitalia and associated structures are essentially similar to c. *conica*.

TYPE MATERIAL : Holotype female, Top Camp, 2100 m, 4. II. 1939 (L. J. Toxopeus) ; 2 paratopotype females and 1 paratopotype male, 20-29. I. 1939 (L. J. Toxopeus) ; 1 paratype female, Mist Camp, 1800 m, 12. I. 1939 (L. J. Toxopeus) .

DISTRIBUTION : W. New Guinea.

(IV) Subgenus **Heterorhiza** Cockerell

Cockerell, 1929, p. 9; Michener, 1965, p. 146.

Type-species : ***Palaeorhiza melanura*** Cockerell, 1910

This is a distinctive subgenus of *Palaeorhiza* which is characterized by Michener (1965) as follows: Seventh metasomal tergum of male broad, with a pair of latero-apical horns, the apices of which are often exposed; propodeal triangle with strong radiating ridges ; inner hind tibial spur of female pectinate; body non-metallic, with extensive yellow markings.

In addition, the species of this subgenus have the following characters in common : Head long; malar space usually long; mandible parallel-sided, bidentate in female, simple in male; 2nd submarginal cell of fore wing small; thorax very densely and usually strongly punctate (but punctures small in *eximia* and *moluccensis*) ; apical margin of male 7th tergum either with a pair of triangular projections or undulated; apical margin of male 5th sternum with a row of decumbent dense hairs, absent in *moluccensis* only; male 6th sternum subquadrate with apical margin entire or emarginate.

The present material includes six species of this subgenus, four of which are described as new species.

KEY TO THE SPECIES OF *Heterorhiza* REPORTED IN THIS PAPER

| | |
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| 1. Female | 2 |
| - Male | " 7 |
| 2. Malar space pale lemon yellow or whitish, considerably longer than basal width of mandible ; propodeal enclosure dull, densely, undulately fluted ; dorso-apical portion of propodeum with a pair of small swellings close to enclosure, a feature similar to <i>Palaeorhiza s. str.</i> and <i>Zarhiopalea</i> ; fore tarsi very long, slender | <i>misoolensis</i>, new species |
| - Insects not as above | 3 |
| 3. Metasoma with three basal segments red (with yellow markings on terga) | 4 |
| - Metasomal segments not red | 5 |
| 4. Malar space a little longer than basal width of mandible ; punctures on thorax rather small; propodeal enclosure somewhat dull, with close undulated carinae | <i>eximia</i> |
| - Malar space shorter than basal width of mandible ; punctures on thorax strong; propodeal enclosure shining, with strong, obliquely running carinae | <i>amabilis</i>, new species |
| 5. Four basal terga each with a considerably broad, entire, yellow band basally (that of 4th usually hidden) ; propodeal enclosure somewhat dull, with dense undulated carinae ; malar space oblique, a little longer than basal width of mandible in the middle; punctures on mesoscutum small and very close | <i>moluccensis</i>, new species |
| - Basal terga with lateral yellow (or whitish) marks only | 6 |
| 6. Large, black species with marking on body yellow; propodeal enclosure more or less well convex, very shining, with strong carinae running rather obliquely; apical margins of 2nd and 3rd terga weakly constricted, with impunctate space very narrow | <i>grandis</i>, new species |

- Medium-sized, black species with marking on body ivory; propodeal enclosure rather flat medially, shining (but not distinctly so), with slender carinae also running obliquely ; apical margins of 2nd and 3rd terga distinctly constricted, broadly impunctate or with sparse and very weak punctures **lusoria** (=enixa)
- 7. Metasoma red basally (with yellow margins on terga)..... 8
- Metasoma not red, or occasion ally piceous 9
- 8. Malar space distinctly longer than basal width of mandible ; punctures on thorax not strong; propodeal enclosure undulately and densely fluted, somewhat dull **eximia**
- Malar space as long as basal width of mandible; punctures on thorax strong; propodeal enclosure very shining, with large longitudinal carinae not undulated **amabilis**, new species
- 9. Exposed terga each with a very broad, entire yellow band basally; malar space slightly longer than basal width of mandible ; propodeal enclosure irregularly or undulately fluted, weakly shining; punctures on thorax small but very close **moluccensis**, new species
- Large species; yellow markings on three basal terga broadly interrupted in the middle of each tergum; malar space a little longer than basal width of mandible ; punctures on mesoscutum not large enough for the size of insect; propodeal enclosure very shining, with strong carinae not undulated **grandis**, new species

(4) Palaeorhiza (Heterorhiza) eximia (Smith)

Prosopis eximius Smith, 1861, Jour. Proc. Linnean Soc., London, Zool., 5: 131, female. Batjan.

Palaeorhiza (Heterorhiza) exima (sic): Michener, 1965, Bull. Amer. Mus. Nat. Hist., 130: 146.

This is a richly decorated species whose metasoma is ferruginous as in *melanura* Cockerell, an Australian species. Unlike the latter, the longitudinal ridges on the propodeal enclosure are undulated and the metepisternum is strongly transversely ridged.

Female: Length about 10 mm.

Relative head measurements : length, 40; width, 36; upper interocular distance, 19; width of face, 24; lower interocular distance, 15 ; eye length, 30; length of clypeus, 19.5, that of clypeus below line tangential to lower margins of eyes, about 8. Inner eye margins strongly converging below; malar space slightly longer than basal width of mandible (about 6 : 5); clypeo-ocular distance not specially broad; postocellar distance : width of posterior ocellus : ocellocular distance as 10 : 7.5 : 11. Collar of pronotum rather thick and rounded on lateral portions; propodeal enclosure densely and undulately ridged (ridged or fluted straight in *melanura*); metepisternum with strong ridges or carinae characteristic to this species; precoxal carina on lower portion of mesepisternum rather weak. Wings with 2nd submarginal cell about one-third as long as 1st along lower margin ; 1st recurrent vein (1st m-cu) interstitial with 1st cubital vein (slightly variable but not separated from the latter



Fig. 2. *Palaeorhiza (Heterorhiza) eximia* (Smith).
Frontal view of the female head.

beyond one vein width); 2nd recurrent vein ending very close to the end of 2nd submarginal cell; stigma slender. Legs slender; fore tarsus slender, with basitarsus a little longer than next four segments taken together excluding claws (about 14 : 13), 2nd segment about one and one-half times as long as broad, and polliniferous hairs well developed. Metasoma well convex dorsally, subcylindrical as usual; 2nd tergum, when broadly exposed, well constricted basally (scarcely constricted in *melanura*).

Punctures on lower half or more of head including clypeus obsolete, only microscopical, sparse; punctures on upper portion of head near ocellar triangle rather distinct; thorax very densely punctate, but punctures not strong; mesoscutum with interspaces of punctures linear, nearly dull (shining in *melanura*); pre-episternum and upper portion of mesepisternum punctate nearly as in mesoscutum (or punctures very slightly stronger); lower portion of the latter and underside of thorax coarsely sculptured (more roughened than in *melanura*); propodeum more strongly punctate than in mesoscutum except for space next to lower metepisternum where punctures very fine and close (this finely punctate space, although not sharply defined, broader than in *melanura*); longitudinal, undulated ridges on propodeal enclosure dense. Metasomal terga densely punctate, although punctures not strong, and microscopically shagreened, without glabrous apical margins.

Malar space, paraocular area, genal area except posterior portion, median stripe of head which is not separated from mid ocellus and broadened on apical portion of clypeus, labrum and basal mark of mandible lemon yellow; mandible reddened; clypeus reddish brown laterally; face, vertex and space behind ocelli black or nearly so; unlike *melanura*, no yellow band along preocipital carina. Antennae (including scapes) reddish brown, slightly darkened above. Mesoscutum black with four broad, longitudinal yellow stripes not reaching anterior margin; the rest of thorax yellow with following black or blackish marks or portions: median portion of scutellum, sometimes a spot

on metanotum, base of propodeal enclosure, long marks on propodeum along lateral margin of enclosure, median transverse band on pronotum, metepisternum except upper portion, anterior portion next to lower metepisternum, and often a pair of large marks on underside of thorax. Legs ferruginous and yellow. Wings brownish subhyaline, distal portions darkened; veins and stigma brown; tegulae pale reddish brown subhyaline with pale yellow mark. Three basal terga ferruginous with yellow lateral markings; 4th tergum yellow basally, piceous or more reddened with metallic tinge apically; next two terga blackish with metallic tinge; four basal sterna pale ferruginous; 4th sternum with a pair of round dark marks; 5th and 6th sterna reddish brown or blackish.

Hairs yellowish white on head and thorax, not conspicuous, those on mesoscutum only slightly brownish in some light; three basal terga with short, dense, appressed golden hairs, distinct even on apical margins; hairs on apex of metasoma blackish.

Male: Differs from description of female as follows :

Relative head measurements : length, 42; width, 36; upper interocular distance, 18; width of face, 23; lower interocular distance, 14; eye length, 31; length of clypeus, 21, that of clypeus below line tangential to lower margins of eyes, about 10. Malar space longer than in female, longer than basal width of mandible (about 7 : 5); clypeo-ocular distance slightly longer than in female, a little shorter than width of mid ocellus. Scape short, shorter than three distal segments of flagellum taken together; flagellum with 1st segment slightly longer than broad, 2nd broader than long, 3rd about as long as 1st. Seventh tergum with apex very broad, apical margin emarginate in the middle or undulated, latero-apical horn distinct; 4th sternum with transverse, glabrous, weak elevation about in the middle; similar elevation on base of next sternum. Fringe of decumbent hairs on 5th sternum dark golden. Marking on head whitish on lower portion; clypeus nearly entirely whitish.

SPECIMENS EXAMINED: 12 females and 5 males, N. Moluccas, 0 m, S. Batjan, VI-VII. 1953 (A. M. R. Wegner). The type locality of this species is Batjan.

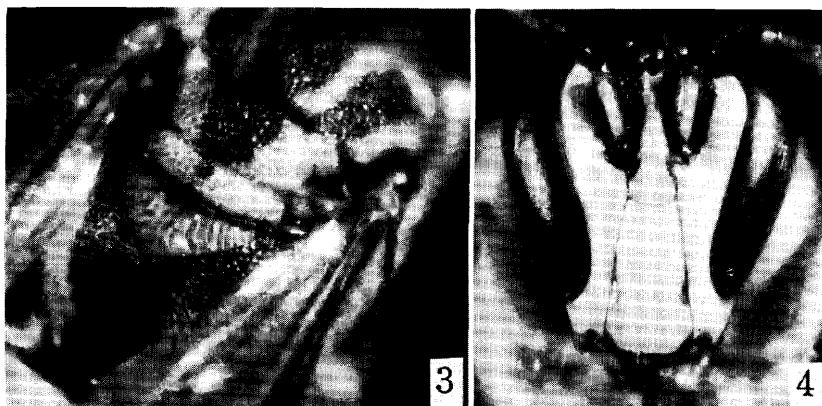
DISTRIBUTION : Moluccas (Batjan).

(5) *Palaeorhiza (Heterorhiza) amabilis*, new species

This is a distinct species related to *eximia* (Smith), but is easily separable from the latter in having the malar space shorter, the punctures on the head and thorax stronger, the radiating ridges on the propodeal enclosure stronger and not undulated, and the transverse ridges on the metepisternum distinct on upper portion only. This is known from New Guinea.

Female: Length about 10 mm.

Relative head measurements : length, 38.5; width, 37; upper interocular distance, 18.5; width of face, 24.5; lower interocular distance, 15; eye length,



Figs. 3-4. *Palaeorhiza (Heterorhiza) amabilis*, new species. 3: Dorsal view of the posterior part of the female thorax. Note the sculpturing of the propodeal enclosure. 4: Frontal view of the male head.

31; length of clypeus, 18, that of clypeus below line tangential to lower margins of eyes, about 6. Inner margins of eyes strongly converging below like *eximia*; malar space very slightly shorter than basal width of mandible (about 4 : 5); clypeo-ocular distance narrow like *eximia*; vertex well convex (slightly more convex than in *eximia*), distinctly punctate, punctures stronger than in *eximia*. Thorax strongly and exceedingly densely punctate, punctures much stronger than in *eximia* and *melanura*; propodeal enclosure with radiating ridges strong, not undulated, rounded, smooth and shining; this feature characteristic to this species; lower portion of mesepisternum and underside of thorax very coarsely sculptured (more strongly and coarsely sculptured than in *eximia*). Fore tarsus similar to that of *eximia* but slightly robuster. Metasomal terga more distinctly punctate than in *eximia*; apical margin of 2nd tergum narrowly glabrous; that of 3rd tergum also glabrous but less distinctly indicated.

Coloration similar to *eximia*, but black portions on head and thorax broader; clypeus black with yellow median line; head without yellow band along preoccipital carina like *eximia*; dorsal and posterior faces of propodeum black; mesepisternum with large blackish mark below, or thorax rarely all black beneath; three basal terga ferruginous like *eximia*, with yellow markings broader; 3rd tergum often with a pair of round dark markings.

Male: Similar to female except as follows :

Relative head measurements : length, 40, width, 37; upper interocular distance, 18.5; width of face, 24; lower interocular distance, 15; eye length, 31.5; length of clypeus, 19, that of clypeus below line tangential to lower margins of eyes, about 7. Malar space a little longer than in female, about as long as or a little longer than basal width of mandible, all ivory like clypeus, paraocular area and genal area; scape short and yellow in front as in

eximia; clypeo-ocular distance slightly longer than in female, about as long as in *eximia*. Apical margin of 7th tergum with a pair of large triangular projections; latero-apical horn of 7th tergum long; 4th and 5th sterna with transverse glabrous elevations more distinct than in *eximia*; sterna rather hairy.

TYPE MATERIAL : Holotype female, Hollandia, VII. 1938 (L. J. Toxopeus) ; 4 paratotype females and 1 paratotype male, same data as holotype.

DISTRIBUTION: W. New Guinea.

(6) ***Palaeorhiza (Heterorhiza) misoolensis*, new species**

Unfortunately this is described from the type female only. This is an interesting species and is unusual in having the fore tarsi very long and slender, malar space very long and propodeum provided with a pair of small elevations near the apex of enclosure. The latter recalls the feature of *Palaeorhiza s. str.* and *Zarhiopalea*. The radiating ridges on the propodeal enclosure are undulated as in *eximia*.

Female: Length about 10 mm.

Relative head measurements : length, 40 ; width, 37.5; upper interocular distance, 18; width of face, 23; lower interocular distance, 17.5 ; eye length, 30; length of clypeus, 21, that of clypeus below line tangential to lower margins of eyes, about 10. Inner margins of eyes slightly converging below, therefore lower interocular distance longer than in *eximia* and *amabilis*; malar space slightly less than twice as long as basal width of mandible (longest among the named species of *Heterorhiza*); clypeo-ocular distance very long, longer than width of mid ocellus ; supraclypeal area less convex than in *eximia* and *splendida*; ocelli larger than in the two latter species, close together; postocellar distance subequal to width of mid ocellus, subequal to that of posterior ocellus, which is slightly shorter than ocellocular distance (about

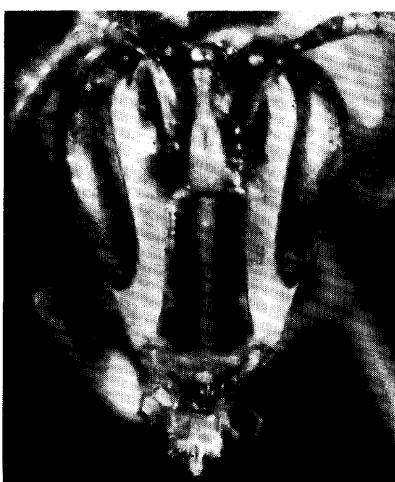


Fig. 5. ***Palaeorhiza (Heterorhiza) misoolensis*, new species.** Frontal view of the female head.

8 : 10) ; posterior ocelli on top of head; space between posterior ocelli and preoccipital carina very slanting (more acutely slanting than in *melanura* and *eximia*). Collar of pronotum receding like that of *melanura*, apical portion of propodeal enclosure between the elevations, which are rather widely separated, slightly depressed; undulated ridges on propodeal enclosure close together. Stigma of fore wing long; 2nd submarginal cell less than half of 1st along lower margin (about 21 : 9.5) ; 1st recurrent vein interstitial with 1st cubital vein as in *eximia*; 2nd recurrent vein separated from the end of 2nd submarginal cell by about two vein widths; basal vein distad of nervulus. Legs slender; fore basitarsus only slightly shorter than fore tibia (about 20 : 23), slightly less than twice as long as next four segments together excluding claws (about 12 : 20) ; 2nd segment of fore tarsus a little more than twice as long as broad; polliniferous hairs on fore tarsus well developed. Metasoma not cylindrical as in *eximia*, *amabilis* or *melanura* but dorso-ventrally slightly compressed ; 2nd tergum well convex latero-medially, therefore apical depression apical to this swelling well indicated, broad.

Thorax very densely and strongly punctate as usual for the subgenus; punctures on mesoscutum and mesepisternum slightly stronger than in *eximia* and *melanura*, weaker than in *amabilis*; lower portion of mesepisternum and underside of thorax more coarsely sculptured than in *eximia*; this feature similar to *amabilis*; propodeal enclosure (or radiating ridges on enclosure) microscopically shagreened, therefore dull (smooth and shining in *melanura* and *amabilis*, slightly shagreened but rather shining in *eximia*). Punctures on metasomal terga, especially those on 2nd and 3rd, more distinct than in *eximia*, similar to *amabilis*; four basal terga with a glabrous apical margin, which is very narrow on 1st tergum, broad but not sharply defined on 2nd, broad and well marked on 3rd, narrow on 4th; these features also characteristic to this species.

Malar space, paraocular areas below antennae, posterior portion of head including genal area, mouth parts and apical margin of clypeus whitish or nearly so except mandibles slightly reddened apically; clypeus pale reddish brown with median line whitish; paraocular areas above antennae and median stripe on frons pale yellow; the latter not separated from mid ocellus; narrow space below antennae brownish; frons, vertex and space behind ocelli black; no yellow band along preoccipital carina. Mesoscutum black with four more or less broad yellow stripes which do not reach the apical margin of mesoscutum; the rest of thorax yellow (paler below) with following marks black or blackish: median transverse band on pronotum, median oval mark on scutellum, extreme lateral portions of axilla and scutellum, basal mark on propodeal enclosure enlarged triangularly in the middle, longitudinal mark on propodeum lateral to lateral margin of enclosure, mark on pre-episternum, and small transverse spot on upper portions of meso- and meta-episterna.

Legs pale yellow or whitish; tarsi slightly brownish ; dorsal faces of femora and tibiae of mid and hind legs darkened; femora and tibiae of fore legs also slightly darkened on posterior faces. Wings slightly brownish subhyaline, distal margins slightly darkened; veins and stigma brown; blackish hairs on wings shorter, especially on basal portions, therefore less distinctive than in *eximia* and *amabilis*; tegulae pale ferruginous subhyaline, with an indication of whitish mark on anterior portion. Second tergum shining black or piceous with slight blue and purple tints, except for extreme basal and lateral margins yellowish; 3rd tergum like 2nd (but slightly more black) with basal portion broadly pale yellow; 4th and following terga black with blue tint; 5th and 6th sterna and apical portion of 4th sternum black or nearly so; the rest of metasoma pale yellow or yellowish except for dorsal face of 1st tergum slightly ferruginous ; 1st tergum with a pair of transverse dark marks in the middle and with an indication of presence of a pair of large yellow markings on basal portion.

Hairs sparse, white and shining on head and thorax; hairs on mesoscutum short, only slightly brownish in some light; long hairs on 3rd and following terga black.

TYPE MATERIAL : Holotype female, Fakal, 0-75 m, Misool, 28. IX. 1948 (M. A. Lieftinck, No. 85).

DISTRIBUTION : Misool.

(7) *Palaeorhiza (Heterorhiza) lusoria* (Smith)

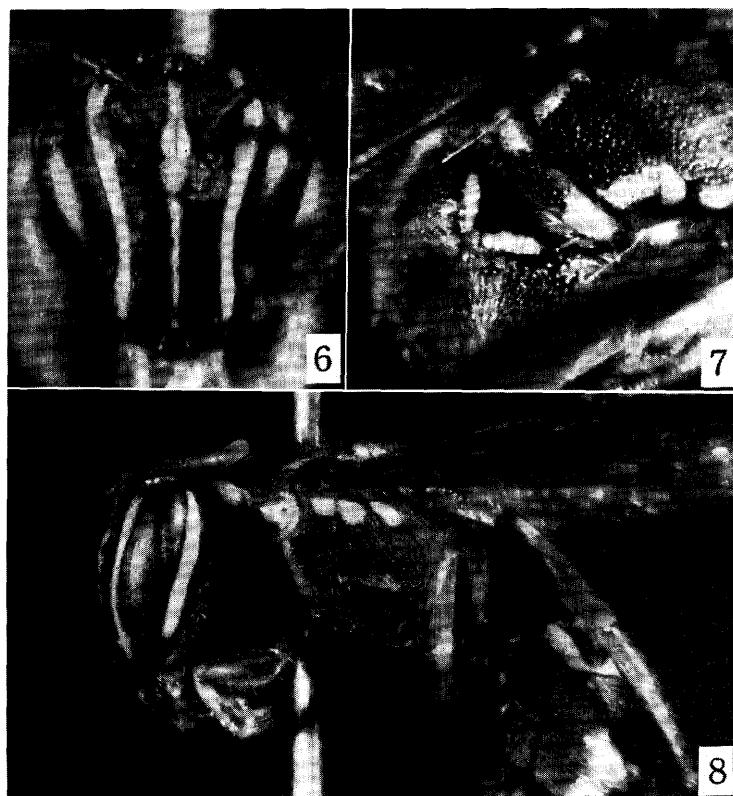
Prosopis Zusoria Smith, 1863, Jour. Proc. Linnean Soc., London, Zool., 7: 44, female. Misool.

Palaeorhiza enixa Cheesman, 1948. Ann. Mag. Nat. Hist., (12)1: 332, female and male. New Guinea. New **synonymy**.

The above synonymy was confirmed by Lieftinck by comparison of the types of *Zusoria* (Smith) and *enixa* Cheesman. The present material of *lusoria* includes 9 female specimens from Misool.

Female: Length, with metasoma slightly downbent, about 9 mm.

Relative head measurements : length, 40; width, 38; upper interocular distance, 19.5 ; width of face, 25; lower interocular distance, 16; eye length, 32; length of clypeus, 20, that of clypeus below line tangential to lower margins of eyes, about 7. Inner eye margins distinctly converging below; malar space about equal to basal width of mandible; clypeo-ocular distance short, shorter than width of mid ocellus; vertex well convex, rather strongly punctate, punctures coarser and stronger than in *moluccensis*, new species and *grandis*, new species. Thorax strongly and very densely punctate; punctures on mesoscutum and scutellum stronger than in *moluccensis*, only slightly weaker than in *grandis*; punctures on scutellum stronger than those on mesoscutum; mesepisternum with upper portion similarly punctate as in mesoscutum, lower



Figs. 6-8. *Palaearhiza (Heterorhiza) lusoria* (Smith). 6: Frontal view of the female head. Dorsal view of the female thorax. 8: Lateral view of the female.

portion and underside of thorax very coarsely sculptured ; propodeal enclosure with radiating ridges not undulated, ridges and furrows between them smooth, shining. Legs slender ; fore tarsus more or less broad, with polliniferous hairs well developed ; fore basitarsus shorter than fore tibia (about 20 :14), about as long as next four segments together; 2nd segment of fore tarsus slightly longer than broad. Metasoma well convex dorsally; 2nd and 3rd terga with apical portions constricted and apical margins reflexed; these constricted portions sparsely and weakly punctate, and apical margins more or less broadly glabrous ; apical margin of 1st tergum also glabrous in the middle ; 1st tergum not at all constricted apically.

Black, with following marks or portions ivory: five stripes on head (three facial stripes more or less narrow, stripe on clypeus linear and narrower than that on frons which reaches mid ocellus), band on pronotum, four slender stripes on mesoscutum (usually broadly separated from the anterior margin of mesoscutum), axilla, lateral longitudinal mark on scutellum, lateral transverse mark on metanotum, V-shaped mark on propodeal enclosure (often

separated), tubercle, three transverse marks at sides of thorax below wing bases, vertical mark on anterior portion of pre-episternum, median transverse mark on mesepisternum, L-shaped mark on lateral portion of 1st tergum, short transverse basal mark on 2nd tergum and corresponding small mark on 3rd tergum (sometimes evanescent or rarely absent), anterior face of fore tibia, and basal marks on mid and hind tibiae; legs piceous or sometimes more paler ;scape reddish in front.

Hairs on head and thorax short, white (dense and rather distinct on propodeum and metepisternum only) ; hairs also white on three basal terga, black on three apical terga.

No male specimen is available from Misool. Cheesman (1948) describes the male of *enixa* from New Guinea.

SPECIMENS EXAMINED : 9 females, Waima, 0-75 m, Misool Id. (W.), 8. IX. — 20. X. 1948 (M. A. Lieftinck, No. 82); 2 females of them bearing further data as follows: Fageo River, Waima, at flower of ***Acanthacea***, 10/IX.

DISTRIBUTION: Misool and New Guinea.

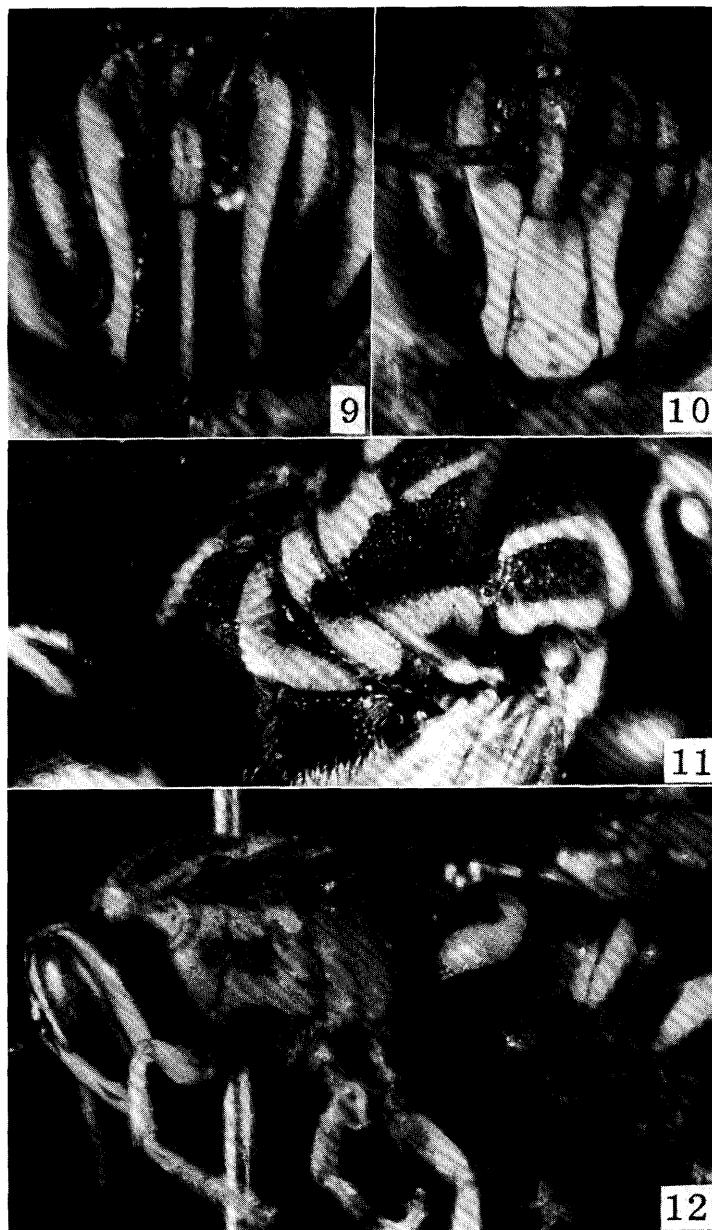
(8) *Palaeorhiza (Heterorhiza) grandis*, new species

So far as we know, this is the largest species in the subgenus and one of the largest species in the genus. This is essentially a black species having a rich yellow decoration, the design of which is similar to *lusoria* (Smith). The punctuation of the thorax is very strong like *lusoria* (Smith) and *amabilis*, new species. The propodeal enclosure is also smooth and shining with non-undulated strong ridges similar to *amabilis*.

Female: Length about or slightly less than 11 mm ; occasionally smaller.

Relative head measurements : length, 45.5 ; width, 43.5; upper interocular distance, 22; width of face, 27.8; lower interocular distance, 19 ; eye length, 35.5 ; length of clypeus, 21.5, that of clypeus below line tangential to lower margins of eyes, about 8. Inner eye margins distinctly converging below except for about upper one-fifth which converges toward ocelli; malar space slightly oblique, about as long as basal width of mandible; clypeo-ocular distance not specially long; width of posterior ocellus : postocellar distance : ocelloocular distance : ocellooccipital distance as about 9 : 11 : 13 : 17. Thorax strongly, densely rugoso-punctate ; punctures on pre-episternum and upper portion of mesepisternum slightly weaker than those on mesoscutum; lower portion of mesepisternum and underside of thorax coarsely sculptured ; precoxal carina rather weak ; metepisternum with upper portion transversely distinctly ridged, lower portion lacking ridges but densely covered with short tomentum; propodeal enclosure smooth, very shining, with radiating ridges strong, not undulated; unlike *lusoria* (Smith), these radiating ridges broad, rounded and close together (narrow, sharp and well separated from each other in *lusoria*). Metasomal terga well punctate; basal face and medio-basal portion of 1st tergum

with punctures obsolete; apical margin of 2nd tergum narrowly impunctate, but this impunctate margin not sharply defined; apical impunctate margin of 3rd tergum narrower and more obscured than in 2nd.



Figs. 9-12. *Palaearhiza (Heterorhiza) grandis*, new species. 9: Frontal view of the female head. 10: Frontal view of the male head. 11: Dorsal view of the female thorax. 12: Lateral view of the male.

Head and thorax black with rich yellow markings or portions as follows: mark on labrum, five long stripes on head, band on pronotum, four stripes on mesoscutum not reaching anterior margin, axilla, lateral broad stripe on scutellum, metanotum except median round black mark, V-shaped mark on propodeal enclosure, tubercle, interrupted band at side of thorax below wing bases, lower portion of pre-episternum, band on median portion of mesepisternum, lower portion of metepisternum and anterior mark on tegulae; scape reddish, flagellum darker. Wings dark, distinctly darkened distally; veins and stigma brown; tegulae ferruginous subhyaline. Legs reddish brown with yellow markings especially on tibiae; tarsi darker than tibiae. Metasoma black with very slight metallic tint like *lusoria* (Smith); 1st tergum piceous basally in the holotype female; metasoma with following marks yellow: a pair of L-shaped narrow marks on lateral portion of 1st tergum and a pair of short bands on basal portions of 2nd and 3rd terga.

Head scanty of hairs; hairs on head and thorax yellowish except for those on propodeum grey; hairs covering posterior face of propodeum dense, more or less long and somewhat decumbent; this hair covering much more conspicuous than in other consubgeneric species; hairs covering lateral face of propodeum also conspicuous; hairs on three basal terga whitish except for apical portion of 3rd intermixed with brown hairs; hairs on three apical terga blackish; hairs on sterna white but those on 6th sternum and apical portion of 5th brownish.

Male: Similar to female but differs as follows :

Relative head measurements : length, 44; width, 42; upper interocular distance, 21; width of face, 26; lower interocular distance, 18; eye length, 35.5; length of clypeus, 21. that of clypeus below line tangential to lower margins of eyes, about 9. Malar space a little longer; space between clypeus and eye broader; median portion of supraclypeal area slightly more convex. Scape short as usual for the subgenus; flagellum with 1st segment longer than broad, about equal to 3rd; 2nd much broader than long. Metasoma long; 1st tergum large, well convex basally and latero-basally; 7th tergum with a pair of triangular projections on apical margin, latero-apical horn long; 4th sternum with a transverse low tubercle which is glabrous; 5th sternum with a similar but weaker tubercle and with a row of golden, decumbent, rather dense hairs on apical margin; 6th sternum broad, quadrate, apical margin slightly emarginate.

Clypeus and paraocular area nearly all ivory but upper portion of the latter yellowish; mandible with basal ivory spot; scape yellow in front; sometimes frontal stripe not reaching mid ocellus (in two out of five specimens); legs more yellow; yellow marks on three basal terga slightly larger; 4th and 5th terga each with a complete (or nearly so) yellow band basally (only visible when the metasoma is fully extended).

TYPE MATERIAL : Holotype female, 3 paratotype females and 5 paratotype males, Bernhard Camp, 50 m, VII-XI. 1938 (J. Olthof).

DISTRIBUTION: W. New Guinea.

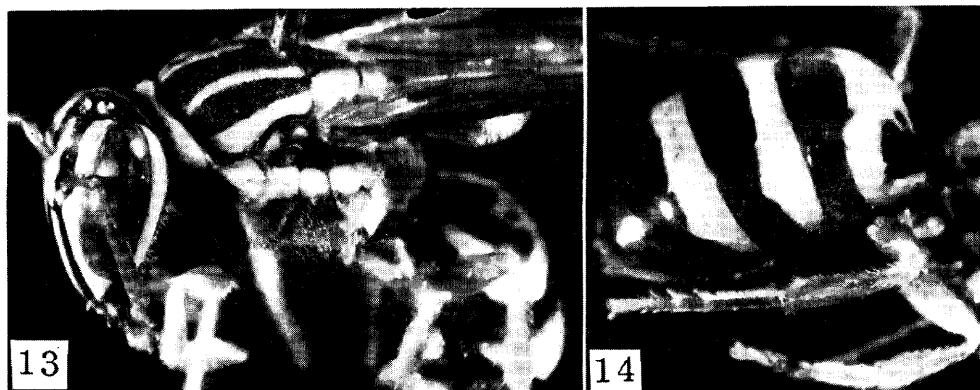
(9) *Palaeorhiza (Heterorhiza) moluccensis*, new species

This is a very striking species having rich yellow markings on the head, thorax and metasoma. The markings of the latter are represented by broad entire basal bands on four basal terga, but the band on 4th tergum is often concealed. The ground coloration of this species including the metasoma is black.

Female: Length slightly less than 10 mm.

Relative head measurements : length, 42.5; width, 38; upper interocular distance, 18.5; width of face, 24; lower interocular distance, 15.5 ; eye length, 33 ; length of clypeus, 21.5, that of clypeus below line tangential to lower margins of eyes, about 8. Inner eye margins strongly converging below; malar space long, distinctly oblique, a little longer than basal width of mandible in the middle; clypeo-ocular distance about equal to width of pedicel, shorter than width of mid ocellus; supraclypeal area distinctly convex, with rounded lateral margins ; ocelli rather large ; postocellar distance: width of posterior ocellus : ocellocular distance : ocelloccipital distance as 10 : 8 : 11 : 15. Collar of pronotum rather thick and rounded on lateral portions, receding and transversely sharply ridged above in the middle; propodeal enclosure with irregular and undulated ridges sometimes not distinctly radiating ; underside of thorax strongly, transversely and densely ridged; lower portion of mesepisternum also coarsely sculptured but less weakly so than the latter; pre-coxal carina very strong, with an indication of longitudinal arm in the middle. Legs slender ; fore tarsus with polliniferous hairs well developed; basitarsus shorter than fore tibia (about 21 : 15), a little longer than next four segments taken together excluding claws ; 2nd segment slightly longer than broad. Wings with stigma rather large as usual for the subgenus; 2nd submarginal cell distinctly less than half as long as 1st along lower margin (about 9 : 22) ; 1st recurrent vein interstitial with 2nd cubital vein or at most about one vein width basad of the latter. Metasoma well convex dorsally, its outline elliptical as seen from above.

Punctures on frons very close, weak; vertex somewhat roughened ; mesoscutum dull with exceedingly dense, small punctures which are much weaker than in *lusoria* and weaker than in *eximia*; scutellum punctate like mesoscutum but punctures slightly stronger; pre-episternum and upper portion of mesepisternum punctate like mesoscutum ; metepisternum with distinct transverse ridges similar to *eximia* and *amabilis*, but sparser than in the latter; 1st tergum very finely and very closely punctate, somewhat shagreened, therefore only weakly shining, apical margin not glabrous; 2nd tergum similar to 1st but



Figs. 13-14. *Palaeorhiza (Heterorhiza) moluccensis*, new species. 13 : Dorso-lateral view of the female. 14: Dorso-lateral view of the female metasoma.

with linear apical margin glabrous; 3rd with punctures weaker than on 1st.

Head with following marks or portions pale lemon yellow: paraocular area, median longitudinal stripe of face, about half of genal area along eye margin, anterior portion or sometimes nearly all of malar space, round mark on labrum, basal mark of mandible, and narrow band along preoccipital carina ; the latter often interrupted in the middle or sometimes reduced to a pair of transverse marks; the facial stripe often enlarged at apex of clypeus, interrupted at upper margin of clypeus and not reaching mid ocellus; clypeus, malar space, mandible and posterior portion of genal area piceous or red-brown ; frons, and vertex black; scape and pedicel pale yellowish brown; the former sometimes with pale yellow stripe ; flagellum brown above, paler below. Thorax black with rich lemon yellow markings or portions as follows: collar of pronotum, four stripes on mesoscutum, axilla, lateral portion of scutellum, metanotum (often with a median dark spot), V-shaped mark on propodeal enclosure, tubercle, most part of pre-episternum (usually with a medio-posterior dark mark), about upper half of mesepisternum (with a median transverse large dark mark often contiguous to the dark mark on pre-episternum), nearly all space of metepisternum, and most part of lateral face of propodeum ; thus, underside of thorax, base of propodeal enclosure, dorsal face (lateral to enclosure) as well as posterior face of propodeum always black. Wings yellowish, distal portions darkened ; hairs yellowish except for those on darkened portions blackish; costa, subcosta and often stigma brownish, the rest of veins reddened; tegulae reddish brown with yellow mark. Legs ferruginous with not much yellow marks on coxae, femora and tibiae; tarsi slightly brownish. Metasoma black with slight metallic (blue and purple) tint; broad median band on 1st tergum, which is enlarged anteriorly in the middle and prolonged anteriorly on the lateral portions and broad basal bands on 2nd, 3rd and 4th terga, lemon yellow; 3rd sternum often with a pair of

small yellow spots on the lateral portions basally.

Hairs very short, scanty, white or nearly so on head and thorax; hairs on legs, underside of thorax and three basal terga yellowish; hairs on apical portion of metasoma black.

Male: Very similar to female, but differs as follows :

Face much narrower; malar space less oblique, slightly more elongated; clypeus nearly all yellow; facial yellow stripe shorter, narrower and broadly separated from mid ocellus ; median pair of yellow stripes on mesoscutum narrower (much narrower than lateral ones) ; and propodeum less broadly yellow. Scape short, only slightly longer than two distal segments of flagellum taken together; flagellum with 1st segment slightly longer than broad, 2nd ring-like, 3rd slightly longer than broad and shorter than 1st and 2nd combined (about 3.3:5); 7th tergum with latero-apical horns long, not specially widely separated, apical margin of tergum undulated; 6th sternum with apical margin rather deeply emarginate in the middle ; 5th sternum without fringe of hairs on apical margin ; sterna scanty of hairs, without long ones.

TYPE MATERIAL: Holotype female, 19 paratopotype females and 8 paratopotype males, Obi Lake, 160-260 m, W. Obi, Moluccas, VII-XI. 1953 (A. M. R. Wegner).

DISTRIBUTION : **Moluccas** (Obi) .

(V) Subgenus **Paraheterorhiza** Hirashima

Hirashima, 1980, p. 104.

Type-species : **Palaeorhiza hilara** Cheesman, 1948

The subgenus was proposed to include two New Guinean species, which are similar to those of *Eupalaeorhiza* in general appearance. For the characters of this subgenus see Hirashima. Our material includes one species of this subgenus.

(10) **Palaeorhiza (Paraheterorhiza) hilara** Cheesman

SPECIMENS EXAMINED: 1 female, Klamono Oilfields, N. W. New Guinea, 18. - 24. VIII. 1948 (M. A. Lieftinck), at white flower of *Cyrtandra* (Gesneraceae) ; 1 female (on white flowered herb) and 1 male, Fakal, O-75 m, Misool (W.), 8. IX.-20. X. 1948 (M. A. Lieftinck).

DISTRIBUTION: New Guinea and Misool.

NOTE: The flower-visiting habit of this species was observed and the flowers were photographed by Lieftinck at Klamono Oilfields, New Guinea (Fig. 21). According to the collecting data, interestingly, the same flowers were visited by the females of **Palaeorhiza (Eupalaeorhiza) papuana** Meade-Waldo simultaneously. The Klamono Oilfields are located ca. 50 km SE inland from the coastal village Sorong (extremity of the so-called Vogelkop Peninsula).

(VI) Subgenus **Anchirhiza** Michener

Michener, 1965, p. 147; Hirashima, 1978 b, p. 78.
Type-species : ***Palaeorhiza mandibularis*** Michener, 1965

The subgenus was proposed to include one Australian species, *P. mandibularis* Michener, the female of which is unique in having the small clypeus (broadly separated from the eye) and the extraordinarily broad, edentate mandibles. For further characters of importance of the subgenus see Hirashima (1978 b). The type-species was recorded from New Guinea by him. Here we report the second species of this subgenus from New Guinea.



Fig. 15. ***Palaeorhiza (Anchirhiza) affinis*, new species.** Frontal view of the female head. Note the edentate and broad mandible.

(11) ***Palaeorhiza (Anchirhiza) affinis*, new species**

The new species is very similar to *P. mandibularis* Michener, but is differentiated by the characters given below. Unfortunately this is known by the type female only.

Female: Length about 8 mm (with metasoma slightly bending downward), slightly smaller than in *mandibularis*.

Relative head measurements (for *mandibularis* in parentheses) : length, 33 (35); width, 38.5 (42.5); upper interocular distance, 21.5 (24); width of face, 25.5 (29); lower interocular distance, 20.8 (24); eye length, 25.5 (27.5); length of clypeus, 15.5 (15), that of clypeus below line tangential to lower margins of eyes, about 6 (about 5.5). Head relatively longer and face relatively narrower than in *mandibularis*, although very slightly so; clypeus slightly narrower and a little longer than in *mandibularis*; mandible large and edentate as in *mandibularis* but distinctly smaller; malar space relatively longer and less oblique than in *mandibularis*, median length of malar space: basal width of mandible as 12 : 18 (12 : 21 in *mandibularis*); upper portion of supraclypeal area slightly more convex than in *mandibularis*, with sharp lateral edges; punctures

on dorsal face of propodeum lateral to enclosure slightly stronger and slightly sparser than in *mandibularis*; interspaces of punctures of this portion smoother and therefore slightly more shining than in *mandibularis* (microscopically sha-greened and nearly dull in *mandibularis*) ; punctures on 1st tergum much sparser and weaker than in *mandibularis*, although they are very fine and dense in the latter species; punctures on 2nd tergum also much less distinctive than in *mandibularis*, nearly obsolete.

TYPE MATERIAL: Holotype female, Lower Mist Camp, 1400-1700 m, 16. I. 1939 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(VII) Subgenus ***Palaeorhiza*** Perkins

Perkins, 1908, p.29; Michener, 1965, p. 145; Hirashima, 1978 a, p. 90.
Type-species : *Prosopis perviridis* Cockerell, 1905

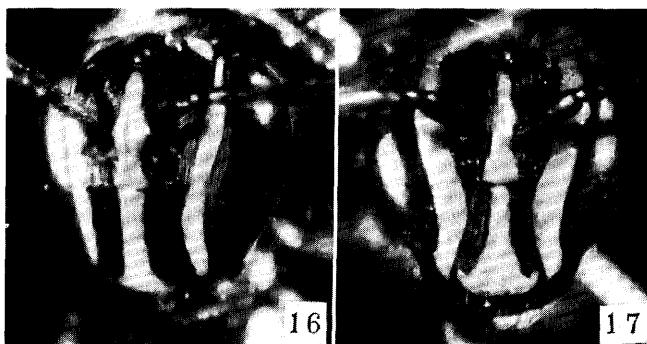
Recently the subgenus was redefined by Hirashima (1978a) to include 13 species from Australia, New Guinea, New Britain, Solomon Islands, Kai, Amboina and Timor. The subgenus is distinctive in having the pair of small swellings on the dorsal face of propodeum apically and the propodeal enclosure, which is long and highly glabrous, is concave between the swellings. In addition, the posterior spur of hind tibia of female is pectinate. Here we describe the 14th species of this subgenus.

(12) ***Palaeorhiza (Palaeorhiza) nitens*, new species**

In general aspect this new species comes closest to *P. montana* Hirashima, but is readily separable from the latter in having yellow markings on the thorax in both sexes (thorax without yellow marking in *montana*).

Female: Length slightly less than 9 mm, rather slender.

Relative head measurements : length, 33 ; width, 35; upper interocular distance, 20; width of face, 24 ; lower interocular distance, 18; eye length, 26; length of clypeus, 14.5, that of clypeus below line tangential to lower margins



Figs. 16-17. *Palaeorhiza (Palaeorhiza) nitens*, new species. 16: Frontal view of the female head. 17: Frontal view of the male head.

of eyes, about 5. Similar to *montana* Hirashima including habitus and punctures, but differs as follows: yellow stripes on head broader; the median yellow stripe of face reaching mid ocellus (in the paratype) or nearly so (in the holotype) and extending laterally at apex of clypeus (broadly separated from mid ocellus and not expanded laterally at apex of clypeus in *montana*) ; transverse large yellow mark in space between eye and posterior ocellus (absent in *montana*) ; thorax with following marks yellow: interrupted band on collar of pronotum, a pair of very slender stripes on mesoscutum, short slender stripe on mesoscutum near tegula (absent in the holotype), and small mark on axilla (absent in the holotype) (thorax without yellow marking in *montana*).

Head and thorax distinctly metallic, shining, with strong dark brassy tint in the holotype, strongly purple in the paratype; metasoma purple, shining; legs piceous with blue and strong purple tint (more purple in the paratype) ; anterior face of fore tibia narrowly yellow (similar to *montana*) ; wings slightly brownish, distal portions more darkened; veins, stigma and tegula brown.

Male : About as large as female.

Relative head measurements : length, 33; width, 34.5 ; upper interocular distance, 20; width of face, 23; lower interocular distance, 15.5; eye length, 26; length of clypeus, 14.5, that of clypeus below line tangential to lower margins of eyes, about 5. Malar space slightly longer than in female, slightly shorter than basal width of mandible (similar to *montana*) ; inner eye margins distinctly converging below (more strongly converging below than in *montana*) ; flagellum with 1st segment as long as 2nd, both broader than long (similar to *montana*) ; yellow mark in space between eye and posterior ocellus contiguous to stripe along eye margin (no yellow mark in space between eye and ocellus in *montana*) ; thorax with more or less rich yellow markings as follows: interrupted band on collar of pronotum, four stripes on mesoscutum (lateral one short in one paratype), triangular mark on axilla, lateral stripe on scutellum, a pair of lateral marks on metanotum (absent in one paratype), and round mark on pre-episternum below tegula (thorax without yellow marking in *montana*) ; the two median yellow stripes on mesoscutum appear to be slightly elevated; punctures on pre- and meso-episterna slightly weaker and sparser than in *montana*; underside of thorax slightly concave with rather dense snow-white hairs (similar to *montana*) ; apical hair fringe on 4th sternum well developed (similar to *montana*). Head and thorax purple like metasoma but darker.

TYPE MATERIAL: Holotype female, Ibèlè Camp, 2250 m, 28. XI. 1938 (L. J. Toxopeus) ; 1 paratopotype male, 25. XI. 1938 (L. J. Toxopeus) ; 1 paratype male, Bernhard Camp, 1500 m, 7. I. 1939 (L. J. Toxopeus) ; 1 paratype female Top Camp, 2100 m, 5. II. 1939 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(VIII) Subgenus **Zarhiopalea** Hirashima

Hirashima, 1982 a, p. 57.

Type-species : ***Palaeorhiza paradoxa*** Hirashima, 1975

This is a small subgenus of ***Palaeorhiza*** which is characterized primarily by the propodeal structure. The propodeal enclosure is finely and densely granulated and entirely dull. The dorsal face of propodeum is provided with a pair of small prominences posteriorly close to the enclosure, a feature similar to ***Palaeorhiza s. str.*** (Hirashima, 1978). Here we report the discovery of the fifth species.

(13) ***Palaeorhiza (Zarhiopalea) facialis*, new species**

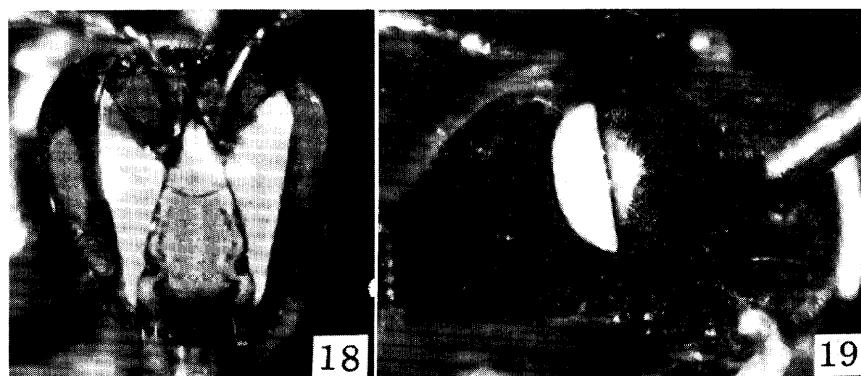
This is described based on two females and one male. The new species is a close relative of ***P. sedlaceki*** Hirashima, but is easily separable by the presence of yellow marking on the scutellum (Fig. 19).

Female: Length about 9 mm.

Relative head measurements: width, 41.0; length, 36.5; upper interocular distance, 19; width of face, 25.5; lower interocular distance, 21; eye length, 30.5; length of clypeus, 17, that of clypeus below line tangential to lower margins of eyes, about 7 ; length of malar space, about 4.5 in the middle.

Differs from ***sedlaceki*** as follows: head broader; upper swelling of supraclypeal area slenderer, less elevated, not dilated laterally ; mesoscutum, scutellum and metanotum with punctures smaller and closer, entirely dull; scutellum slightly more convex, especially on lateral portions ; mesepisternum with much weaker punctures, much more shagreened; two basal metasomal terga with weaker and sparser punctures; scutellum with triangular (or nearly so) yellow mark posteriorly close to large yellow mark on metanotum; and hind tibia without yellow marking antero-basally.

Male: Slightly smaller than female.



Figs. 18-19. ***Palaeorhiza (Zarhiopalea) facialis*, new species.** 18: Frontal view of the female head. 19: Dorsal view of the thorax.

Relative head measurements : width, 35.5; length, 34.5; upper interocular distance, 17; width of face, 21.8; lower interocular distance, 17.6 ; eye length, 27.0; length of clypeus 16.5, that of clypeus below line tangential to lower margins of eyes, about 7.5 ; length of malar space, about 6 in the middle. Head long; inner eye margins only slightly converging below; mandible simple, pointed at apex; malar space distinctly longer than basal width of mandible ; clypeo-ocular distance broad; clypeus and lower portion of supraclypeal area broadly flat; upper portion of the latter triangular as seen in front, rather low; frons flat; vertex not convex as seen in front; ratio of width of posterior ocellus to postocellar distance to ocellocular distance as 3 : 3 : 4; space behind ocelli slanting, slightly concave. Antenna long; scape long; flagellum with 1st segment longer than broad, about as long as pedicel and 3rd segment; 2nd broader than long. Scutellum and metanotum well convex; propodeal enclosure finely shagreened and dull as in female, but not well defined on lateral margins; a pair of small prominences on dorso-posterior portion of propodeum very weak; underside of thorax with pre-coxal carina very strong. First tergum not specially large; sterna without special modification except for a weak transverse elevation on 4th sternum. Genitalia small; gonostylus with dense brown hairs (similar to *variegata* Hirashima) ; penis valves subparallel-sided with sharp lateral keel, apex sharply curved downward, pointed.

Head dark steel blue, with slight greenish tint on frons; mandible and malar space piceous; paraocular area except upper portion, clypeus and supraclypeal area orange red as in female but with ivory marks on lower portion of paraocular area and apical portion of clypeus ;labrum with round yellowish ivory mark. Antenna blackish ; scape with yellowish stripe in front ; flagellum beneath reddish brown except two basal segments. Most part of thorax dull except underside; thorax black with delicate dark metallic shade as in female; underside of thorax bright metallic (brassy with purple tint) also as in female; band on collar of pronotum, triangular mark on posterior portion of scutellum, large and broad mark on metanotum, apical half of tubercle and mark on tegula yellow; tegula ferruginous subhyaline. Wings dark as in female. Legs dark red with slight purple tint; anterior face of fore tibia yellow. Metasoma shining, blue-green dorsally, blue-purple ventrally.

Hairs not conspicuous ; no hair fringe on terga and sterna.

TYPE MATERIAL: Holotype female, Mist Camp, 1800 m, 10. I. 1939 (L. J. Toxopeus) ; 1 paratype male, Top Camp, 2100 m, 20. I. 1939 (L. J. Toxopeus) ; 1 paratype female, Lower Mist Camp, 1700 m, 16. I. 1939 (L. J. Toxopeus).

DISTRIBUTION : W. New Guinea.

(13 a) ***Palaeorhiza (Zarhiopalea) facialis basirufa, new subspecies***

This is known by the female only. The new subspecies differs from the nominate subspecies by the coloration of the metasoma only, as follows: two

basal terga, latero-basal portions of 3rd tergum, and three basal sterna red.

Hirashima (1982 b) reported an interesting variation, which includes the color change, in the male of *P. variegata* Hirashima. It might be possible that *basirufa* is a color form of *facialis*.

TYPE MATERIAL: Holotype female, Sigi Camp, 1500 m, 14. II. 1939 (L. J. **Toxopeus**).

DISTRIBUTION: W. New Guinea.

(IX) Subgenus **Eupalaearhiza** Meade-Waldo

Meade-Waldo, 1914, p. 403; 1923, p. 13.

Type-species : **Eupalaearhiza papuana** Meade-Waldo, 1914 (monobasic and original designation).

Eupalaearhiza was erected as a genus of bees in 1914, and again described in 1923, by Meade-Waldo. Michener (1965) treated this as a synonym of *Palaearhiza*.

This is regarded as a distinct subgenus of *Palaearhiza* in this paper. *Paraheterorhiza* Hirashima (type-species : *Palaearhiza hilara* Cheesman) is most closely related to *Eupalaearhiza*, but the latter is distinctive in having the male 5th sternum completely hidden beneath the preceding sternum, as stated by Meade-Waldo (at least lateral portions exposed in *Paraheterorhiza*), the male 6th sternum strongly convex on the medio-apical portion (flat or nearly so in *Paraheterorhiza* and all other subgenera), the propodeal enclosure not fluted (distinctly fluted in *Paraheterorhiza*), and the median longitudinal carina on the clypeus absent or very weak (distinct in *Paraheterorhiza*) in addition to the elongated male glossa (this is also elongate in the male of the type-species of *Paraheterorhiza*). In addition, the appearance of the frontal view of the head is very different in these two subgenera. Namely, in *Eupalaearhiza*, the eyes larger (longer and more convex than in *Paraheterorhiza*), ocelli larger, upper interocular distance shorter, clypeus shorter, broader (the apical portion of clypeus distinctly broadened, especially in the female *Eupalaearhiza*), and rather flat, and malar space shorter. The pattern of the white (or yellow) markings on the head is also different. The clypeal mark is large, long and parallel-sided, as can be seen in Fig. 22, in the female of *Eupalaearhiza*, while it is small and triangular in *Paraheterorhiza*, and the lower end of stripe on the paraocular area does not extend below the lower margin of eye in *Eupalaearhiza* (at least in two species treated in this paper), but it exceeds distinctly and nearly reaches the base of mandible in *Paraheterorhiza*. Thus, the two subgenera are essentially different although the colour pattern of the body and wings are similar.

Eupalaearhiza includes at least three species, two of which are treated in this paper.

(14) Palaeorhiza (Eupalaeorhiza) papuana (Meade-Waldo)

Eupalaeorhiza papuana Meade-Waldo, 1914, Ann. Mag. Nat. Hist. (8) 13: 404, male. New Guinea.

Palaeorhiza (Palaeorhiza) papuana: Michener, 1964, Bull. Amer. Mus. Nat. Hist., 130: 146.

Redescription of the type male

Length of head and thorax together about or a little over 5 mm ; metasoma greatly extended artificially so that its actual length not measurable; fore wing about or a little less than 10 mm.

Relative head measurements : length, 46.5; width, 43.3 ; upper interocular distance, 20; width of face, 25.2; lower interocular distance, 17.6 ; eye length, 36.5 ; length of clypeus, 23, that of clypeus below line tangential to lower margins of eyes, about 10; length of malar space, about 6.5; basal width of mandible, about 6.5; clypeo-ocular distance, about 4; width of posterior ocellus, 3.2 or 3.3; postocellar distance, 3.5; ocellocular distance, 5.0; ocellooccipital distance, about 5. Eyes large, long, inner margins distinctly converging below except about upper one-fourth which converges toward ocelli; clypeus long, upper margin narrow, narrower than clypeo-ocular distance of the same level (about 5.5 : 7.5) ; clypeus smooth, shining, with median longitudinal carina very weak; supraclypeal area with lower portion weakly and rather loosely longitudinally lineolate, shining, upper portion not dilated laterally; region of antennal sockets distinctly concave; ocelli large, close together; as seen from side, eye large and genal area very narrow. Scape moderate in length, slightly shorter than apical width of clypeus; flagellum with 1st segment slightly longer than broad, longer than 2nd which is broader than long, 3rd also broader than long but a little longer than 2nd, 4th about as long as 1st. Mouth parts: glossa long, slightly longer than head; labial palpus long, relative length of each segment, from base to apex, as about 4.5 : 3.5 : 3.5 : 3 ; galea long; maxillary palpus elongate, much longer than galea, ratio of each segment, from base to apex, as 2.5 (3) : 3 : 4 : 4 : 5 : 5. Collar of pronotum narrow in the middle, somewhat broad and flattened laterally; mesoscutum not strongly convex; scutellum rather flat, about twice as long as metanotum (about 12 : 6.5) ; propodeal enclosure not large, defined by absence of punctures, granular on basal and median portions, smooth and shining only on apical portion ; underside of thorax longitudinally broadly concave in the middle ; precoxal carina weak, short. Wings with hairs rather long; stigma large, about as long as 1st submarginal cell (along lower margin of the latter) ; the latter about 1.5 times as long as 2nd submarginal cell ; lower margin of 2nd submarginal cell (vein M) with 1st abscissa 1/2 as long as 2nd cubital vein, a little longer than 3rd abscissa; 2nd submarginal cell slightly narrowed above. Fore tarsus with basitarsus slightly shorter than next four segments taken together excluding claws (about 14 : 16), 2nd segment longer than broad, and slightly longer than 3rd which is about as long as broad, 4th small and

broader than long; hind tibia thick, even basally as seen from above, surface smooth and shining. First tergum well convex but much lower than 2nd which is distinctly convex and constricted at the base; three basal terga each with a very broad, impunctate, smooth apical margin well indicated; that of 4th tergum slightly narrower but still distinct; 7th tergum distinctly narrowed toward apex, apical margin emarginate, latero-apical corner distinct but not dentate; apical margin of 4th sternum very weakly emarginate in the middle; 5th sternum, when exposed, with apical margin broadly and distinctly emarginate with a tuft of decumbent, nearly golden, well arranged hairs; 6th sternum characteristically shaped, distinctly convex; 7th sternum with long, pubescent arms. Genitalia large, gonostylus with rather long, dense, whitish hairs; penis valves distinctly curved and angulated outwardly, rather flat dorsally (but not broad), enclosing a large, long hollow between valves as seen from above (this is probably one of the most distinctive characteristics of this species).

Head impunctate except for space between ocelli and space behind ocelli; mesoscutum densely punctate, but punctures not strong; scutellum a little more densely punctate than mesoscutum, punctures indistinctly weaker than those on posterior portion of mesoscutum; metanotum densely punctate even in the median portion; dorso-lateral face of propodeum lateral to enclosure distinctly and very densely punctate; lateral face of propodeum also well punctate; pre- and meso-episterna also well punctate like lateral face of propodeum; metepisternum very densely punctate; 1st tergum nearly smooth, shining, with sparse, weak punctures; 2nd similarly sculptured to the latter but punctures coarser.

Head light piceous with malar space, apical portion of clypeus, labrum and mandibles yellowish; broad stripe on paraocular area and large, subparallel-sided mark on clypeus ivory; the lower point of the former not exceeding line tangential to lower margins of eyes; evanescent stripe on scape and small mark on labrum also whitish; scape yellowish in front and basally; pedicel reddish brown; flagellum brown above, yellowish brown beneath, excluding two basal segments which are entirely brown; pronotum blackish dorsally; mesoscutum black, rather dull; scutellum piceous or more reddened with lateral and posterior portions similar to the rest of thorax (including tubercles and tegulae) which is yellowish fulvous or deep honey-colored; interrupted band on collar of pronotum and mark on tubercle ivory; legs, two basal terga and three basal sterna also yellow-fulvous; remaining terga and sterna light piceous with purple reflection; wings with about apical halves distinctly darkened, basal halves yellowish smoky.

Hairs scanty on head, yellowish; hairs on thorax, legs and light-colored portions of metasoma yellow or golden; hairs on mesoscutum not long, downy, brownish; hairs on dark-colored portions of metasoma blackish.



Fig. 20. ***Palaeorhiza (Eupalaeorhiza) papuana*** (Meade-Waldo). Dorso-lateral view of the female.

Two females in the present collection are identified as the female of this species, although the 2nd submarginal cells are slightly smaller than those of the type male.

Female : Length 11.0-U 5 mm.

Relative head measurements : length, 48; width, 48; upper interocular distance, 22; width of face, 28.5 ; lower interocular distance, 20.5; eye length, 39.5; length of clypeus, 24, that of clypeus below line tangential to lower margins of eyes, about 7.5 ; **length** of malar space, about 4.5; basal width of mandible, about 7; clypeo-ocular distance, 4.5 ; width of posterior ocellus, 3.3 ; postocellar distance, 3.8 ; ocellocular distance, 5.8 ; ocellooccipital distance, 4.8. Very similar to male (except for usual sexual differences) but differs as follows : malar space shorter; mandible narrow at apex, bidentate, but with a blunt and oblique corner above; upper portion of supraclypeal area slightly dilated laterally; fore tarsus with 2nd segment about as long as broad, a little larger than 3rd, 4th small and broader than long; and 3rd tergum similar to two basal terga in color except for apical portion piceous with purple tint.

SPECIMENS EXAMINED: 2 females, Klamono Oilfields, N. W. New Guinea, 19. VIII. 1948 (M. A. Lieftinck), on white flower of *Cyrtandra* sp. (Gesneraceae) (Fig. 21). As noted elsewhere, these females were taken with females of *P. (Paraheterorhiza) hilara* Cheesman, on the same flowers.

DISTRIBUTION: New Guinea.

(14 a) ***Palaeorhiza (Eupalaeorhiza) papuana insularis*, new subspecies**

Unfortunately this is known from the type male only from Misool. Essentially as in *P. p. papuana*, but eyes more convex, face more elevated (especially area of upper portion of clypeus and lower portion of supraclypeal area) and *penis valves of genitalia narrow, slender, neither curved nor angulated outwardly as seen*

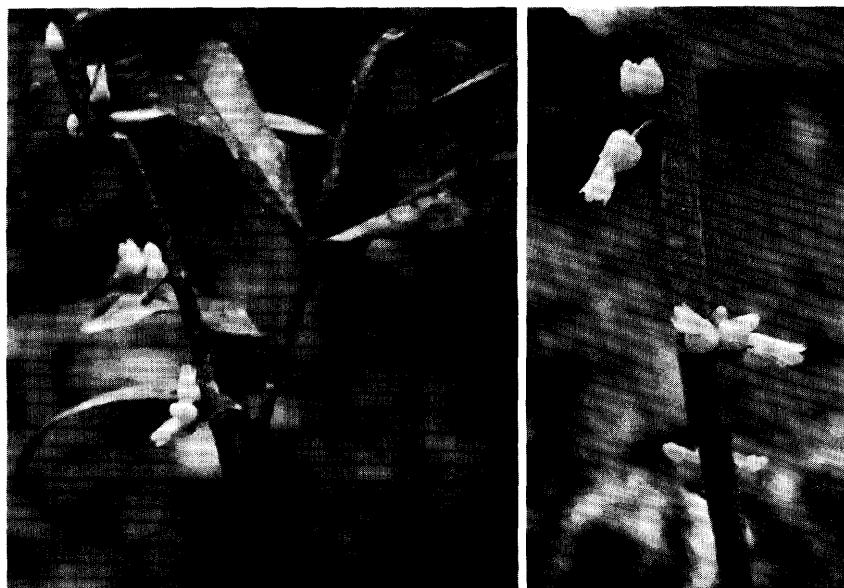


Fig. 21. *Cyrtandra* sp. visited by females of *Palaearhiza* (*Eupalaearhiza*) *papuana* (Meade-Waldo) and *P. (Heterorrhiza)* *hilara* Cheesman. Photo by Lieftinck (August 19, 1948).



Fig. 22. *P. (Eupalaearhiza)* ***papuana papuana*** (Meade-Waldo). Frontal view of the female head.



Fig. 23. *P. (Eupalaearhiza)* *papuana insularis*, new subspecies. Frontal view of the male head. Note the long glossa.

from above. Basal portion of 3rd tergum more broadly ferruginous. Relative head measurements of the type male: length, 44.5; width, 41.5; upper interocular distance, 19; width of face, 24; lower interocular distance, 16.5; eye length, 35.2; length of clypeus, 21.8, that of clypeus below line tangential to lower margins of eyes, about 8.5; length of malar space, about 5.5; basal

width of mandible, about 6; width of posterior ocellus, 3.2 ; postocellar distance, 3.5 ; ocellocular distance, 4.5 ; ocellooccipital distance, 5.0 ; clypeo-ocular distance, 4.0.

TYPE MATERIAL: Holotype male, Fakal, O-75 m, Misool, 8. IX. -20. X. 1948 (M. A. Lieftinck).

DISTRIBUTION : Misool.

(15) ***Palaeorhiza (Eupalaeorhiza) melina*, new species**

This is described by a couple of specimens from the Araucaria Camp, New Guinea. Superficially very close to *P. papuana*, but differs from the latter as follows :

Male: Smaller, head and thorax together about 4 mm, fore wing about 9 mm long.

Relative head measurements : length, 41; width, 40; upper interocular distance, 16; width of face, 22.8; lower interocular distance, 15.5; eye length, 33 ; length of clypeus, 19.5, that of clypeus below line tangential to lower margins of eyes, about 7 ; length of malar space, about 4.5; basal width of mandible, about 5 ; clypeo-ocular distance, about 3.5; width of posterior ocellus, 3.6 ; postocellar distance, 2.8 ; ocellocular distance, 3.0 ; ocellooccipital distance, 3.9. Head broader with eyes more convex; inner eye margins more strongly converging below with upper portion more strongly converging toward ocelli; upper interocular distance narrower ; ocelli larger and ocellocular distance shorter; upper portion of supraclypeal area distinctly elevated and dilated laterally; upper portion of clypeus longitudinally striated as in supraclypeal area where it is more distinctly and densely striated than in *papuana*; punctures on mesoscutum slightly larger and coarser; genitalia with penis valves parallel-sided, neither curved nor angulated outwardly, and each with a distinct keel dorsally (no keel and flattened dorsally in *papuana*); and 3rd tergum honey-colored like the two preceding terga.



Fig. 24. *Palaeorhiza (Eupalaeorhiza) melina*, new species. Frontal view of the male head.

Female: Length about 11.5 mm.

Relative head measurements : length, 45.0; width, 45.5; upper interocular distance, 20.0; width of face, 27 ; lower interocular distance, 19.5 ; eye length, 36.5 ; length of clypeus, 21.5, that of clypeus below line tangential to lower margins of eyes, about 7; length of malar space, about 4.5; basal width of mandible, about 7; clypeo-ocular distance, 4.0; width of posterior ocellus, 3.5; interocellar distance, 3.2 ; ocellocular distance, 4.8 ; ocellooccipital distance, 4.5. Very similar to the female of *papuana* described above but differs from the latter as follows: Inner margins of eyes more converging below with upper portion more converging toward ocelli, although difference between the two species is slight; ocelli larger; postocellar and ocellocular distances shorter; punctures on mesoscutum larger and coarser; ivory mark *on* clypeus smaller and evanescent; 3rd tergum entirely honey-colored; 4th sternum broadly honey-colored basally; and 2nd submarginal cell of fore wing larger.

TYPE MATERIAL: Holotype male, Araucaria Camp, 800 m, New Guinea, 24. III. 1939 (L. J. Toxopeus) ; paratopotype female, 2. IV. 1939 (L. J. Toxopeus) (No. 127).

DISTRIBUTION: W. New Guinea.

(X) Subgenus **Hadrorrhiza** Hirashima

Hirashima, 1980, p. 108.

Type-species : *Prosopis imperialis* Smith, 1863

The subgenus was proposed to include three, large, brilliantly metallic species from New Guinea and Australia. The propodeal enclosure is large, well convex, and coarsely sculptured at least on the apical portion. This is further characterized in having the pterostigma slender, posterior spur of female hind tibia finely serrate (not pectinate) and a large projection on the lower portion of male mesepisternum. Our material includes a species of this subgenus.

(16) ***Palaeorhiza (Hadrorrhiza) lieftincki mutata*, new subspecies**

Palaeorhiza lieftincki Hirashima, 1975, J. Fac. Agr., Kyushu Univ., 20: 28, female. Wissel-meren, W. New Guinea.

Palaeorhiza (Hadrorrhiza) Zieftincki stellaris Hirashima, 1980, J. Fac. Agr., Kyushu Univ., 25: 115, female. W. New Guinea.

Female: Length slightly less than 11 mm.

Relative head measurements : width, 47.0; length, 42.5; upper interocular distance, 23.0; width of face, 29.0; lower interocular distance, 22.5; eye length, 33.5; length of clypeus, 19.0, that of clypeus below line tangential to lower margins of eyes, about 8; length of malar space, 4.5 in the middle (about 5.0 in the middle in *l. lieftincki*) . Very similar to *l. Zieftincki*, but head and thorax beautiful purple, shining (beautiful blue-green with purple shade in some

light in *l. Zieftincki*; legs also purple (green in *l. Zieftincki*) ; and punctures on mesoscutum weaker, which are unusually weak for the size of insect.

TYPE MATERIAL: Holotype female, Balim Camp, 1600 m, 26. XI. 1938 (L. J. Toxopeus).

DISTRIBUTION: N. W. New Guinea.

The three forms of this interesting species may be separable by the following key (female only).

1. Head, thorax and legs brilliant purple ; punctures on mesoscutum weak (unusually small for the size of insect) and rather sparse **lieftincki mutata**
- Head, thorax and legs brilliant green or green-and-purple 2
2. Head, thorax and legs brilliant green; punctures on mesoscutum rather distinct **lieftincki lieftincki**
- Head, thorax and legs brilliant green with strong purple tint; punctures on mesoscutum similar to *lieftincki mutata* **lieftincki stellaris**

(XI) Subgenus **Cnemidorhiza** Hirashima

Hirashima, 1981 b, p. 1.

Type-species : *Prosopis elegans* Smith, 1864 (= *Palaeorhiza elegantissima* (Dalla Torre, 1896))

Our material includes five species of this subgenus, three of which are described as new in this paper. Thus, the subgenus is now known to include 21 species. Interestingly, a new species, *flavescens*, is known to nest in the soil according to the collecting data. This is the second species of *Cnemidorhiza* whose soil-nesting habit is known.

KEY TO THE FEMALES OF *Cnemidorhiza* TREATED IN THIS PAPER

Yellow species with nearly black (weakly metallic) stripes or markings on head and thorax; metasoma pale ferruginous with large yellow markings; black-marked portions on underside of thorax very coarsely sculptured **flavescens**, new species

Metallic species 2

Purple species, with yellow markings restricted to head only; propodeal enclosure large, shining, finely microscopically lineolate ; mesoscutum not very densely punctate **aemula**, new species

Blue or green species, with yellow markings on head and thorax 3

Green species ; no yellow stripe in the middle of mesoscutum; the latter very densely, rather strongly punctate; propodeal enclosure small, finely shagreened, nearly dull; precoxal carina on underside of thorax reversely T-shaped; 2nd tergum acute at latero-apical corner and this portion very densely punctate * **elegantissima**

Mesoscutum with two yellow stripes in the middle in addition to lateral yellow stripes; precoxal carina simple ; 2nd tergum not as above 4

Blue species ; mesoscutum not very densely punctate ; propodeal enclosure without yellow marking; metasoma piceous with strong purple tint, somewhat hairy; legs dark **speciosa**

Green species; mesoscutum very densely punctate ; propodeal enclosure with

a pair of round yellow markings ; metasoma red with purple tint, not hairy ;
legs ferruginous *decorata*, new species

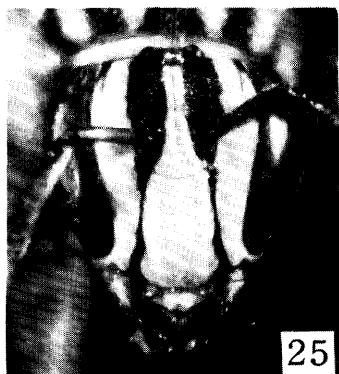
(17) *Palaeorhiza (Cnemidorhiza) flavescens, new species*

Unfortunately this is known from the female only. This is a relative of *P. (Cnemidorhiza) variabilis* Hirashima but is easily separable from the latter and its allied species (the *variabilis* species group) in having the head and thorax more largely yellow (with dark portions not distinctly metallic) and the metasoma paler and less reddish. Thus, in the new species, the clypeus is nearly entirely yellow and the sides and underside of the thorax are also entirely yellow except for a pair of large ventral black markings.

The status of the important subgeneric characteristics of this new species is as follows: caudal fimbria not specially dense, but hairs well appressed on medio-apical portion of 6th tergum; pygidial plate nearly absent; dorsal face of hind tibia broadened and coarsely sculptured basally, but this sculpturing weaker than in *variabilis*; and apical tuft of short hairs on hind femur not distinct.

Female: Length about 8 mm.

Relative head measurements : length, 31; width, 33; upper interocular distance, 17 ; width of face, 22; lower interocular distance, 16; eye length, 25 ; length of clypeus, 14.5, that of clypeus below line tangential to lower margins of eyes, about 4. Inner eye margins slightly converging below; malar space narrow as in *variabilis*; outline of clypeus more arcuate than in *variabilis* as seen in profile ; upper portion of supraclypeal area similar to *variabilis* but narrower and slightly more convex; mesoscutum and scutellum strongly and very densely rugoso-punctate, interspaces between punctures more linear and duller than in *variabilis*; sides of thorax shining, strongly punctate, punctures closer than in *variabilis*; dark-colored portions of underside of thorax very



25



26

Figs. 25-26. *Palaeorhiza (Cnemidorhiza) flavescens*, new species. 25: Frontal view of the female head. 26: Dorso-lateral view of the head and thorax of the female.

coarsely sculptured as in *variabilis*; propodeal enclosure rounded, well convex, slightly less shining than in *variabilis*. Wings rather short for the size of insect (similar to *variabilis*) ; 1st recurrent vein much distad of 1st cubital vein (similar to *variabilis*). Fore tarsi with polliniferous hairs well developed; basitarsus a little shorter than next four segments together excluding claws (about 12 : 13) ; 2nd segment very slightly longer than broad, a little larger than next which is larger than 4th. First tergum smooth, shining, with weak and sparse punctures less evident than in *variabilis*; 2nd tergum also weakly and sparsely punctate, punctures much weaker than in *variabilis*; unlike *variabilis*, 3rd tergum with very weak punctures; apical margin of 1st tergum rather broadly glabrous as in *variabilis*, that of 2nd not distinctly marked in the middle and minutely roughened on lateral portions; 3rd tergum without glabrous apical margin (broad glabrous apical margin still evident on 3rd tergum in *variabilis*).

Head with rich yellow markings as follows : nearly all surface of clypeus and nearly all of supraclypeal area, stripe on frons (not separated from mid ocellus), paraocular area, malar space, genal area except for narrow portion above behind, labrum and basal marks on mandibles ; mandibles and apical and latero-apical margins of clypeus, ferruginous; the rest of head (i.e., frons, vertex and occipital region) black with slight metallic blue tint. Pronotum broadly yellow including collar and tubercles; mesoscutum dark metallic blue or nearly black like head, with four broad yellow stripes ; axilla yellow; scutellum, metanotum and propodeal enclosure yellow with median portion of each area variably (in size) blackened with slight metallic tint; propodeum yellow except for broad longitudinal mark lateral to enclosure and median longitudinal mark on posterior face piceous or more paler; sides of thorax entirely yellow except for large round blackish mark in front of mid coxa. Wings subhyaline, slightly brownish ; costa and subcosta brown, the rest of veins and stigma paler. Legs yellow basally and pale ferruginous apically. Metasoma pale ferruginous (less reddish than in *variabilis*), with two (in the holotype) or three apical terga slightly brownish; lateral portions of three basal terga pale yellow or with pale yellow markings ; 4th tergum pale yellow basally; 2nd to 5th sterna broadly pale yellow basally.

Hairs not conspicuous, those on mesoscutum yellowish brown; no tergal hair fringe ; hairs **on** apical portion of metasoma, including caudal fimbria on 6th tergum, brown.

TYPE MATERIAL: Holotype female, Klamono Oilfields, 24. VIII. 1948 (M. A. Lief tinck) ; paratopotype female, 22. VIII. 1948 (M. A. Lief tinck). These were taken from the nests made in the soil of marly bank.

DISTRIBUTION: N. W. New Guinea.

(18) *Palaeorhiza (Cnemidorrhiza) aemula*, new species

This is a beautiful violet species having yellow markings on the head only. The metasoma and legs are piceous with purple tint. Thus, this is easily recognizable by its distinctive coloration. The mode of punctuation of this new species is similar to that of *P. speciosa* Hirashima. Unfortunately this new species is known from the female only.

The status of more important subgeneric characteristics of this species is as follows: dorsal face of hind tibia very coarsely sculptured; apical tuft of fuscous hairs on hind femora not conspicuous ; caudal fimbria black, dense; and pygidial plate not well indicated.

Female: Length about 8.5 mm; fore wing about 8 mm long.

Relative head measurements: length, 33.5; width, 36.0; upper interocular distance, 19.5; width of face, 23.9; lower interocular distance, 17.5; eye length, 26.5; length of clypeus, 13.8, that of clypeus below line tangential to lower margins of eyes, about 4.5 ; length of malar space, about 1.5 ; basal width of mandible, a little less than 5 ; width of posterior ocellus, 3.0 to 3.1; postocellar distance, 3.5 to 3.8 ; ocellocular distance, 4.7 to 5.0 ; ocellooccipital distance, 5.0. Clypeus and supraclypeal area well convex; upper portion of the latter elevated and sharply defined from frons, dilated laterally with sharp lateral edges ; median sulcus of supraclypeal area distinct; the feature of swollen supraclypeal area somewhat similar to *cyanea* Hirashima; clypeo-ocular distance longer than malar space, which is rather narrow as indicated above. Collar of pronotum well convex dorsally, its outline arched as seen in front, rather narrow, narrowed in the middle; mesoscutum and scutellum well convex; metanotum also convex; propodeal enclosure large, well convex, well indicated by absence of punctures; lower portion of mesepisternum and underside of thorax not coarsely sculptured; precoxal carina moderate. Apical portion of 1st tergum constricted in the middle; 2nd tergum distinctly convex in the middle.

Punctures on frons and upper portion of head distinct, slightly coarser and sparser than in *speciosa*; mesoscutum well punctate, as in *speciosa*, but



Fig. 27. *Palaeorhiza (Cnemidorrhiza) aemula*, new species. Frontal view of the female head.

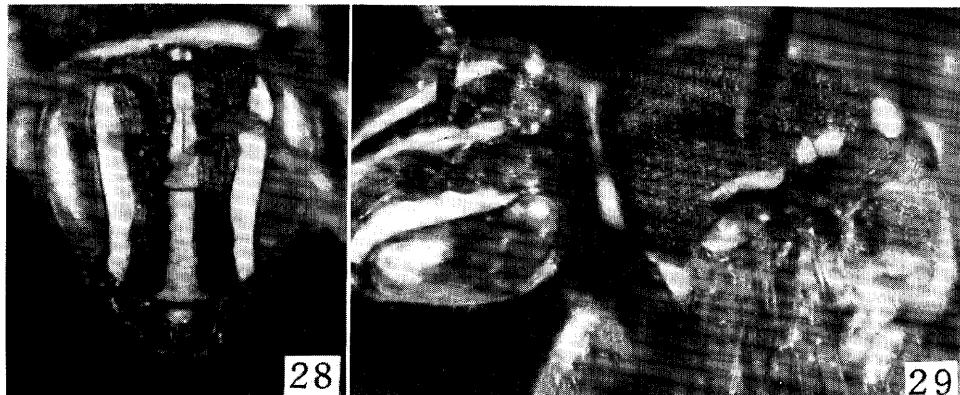
much sparser than in *elegantissima*; scutellum sparsely, somewhat weakly punctate; metanotum very weakly, sparsely punctate; punctures on pre-episternum a little weaker than those on mesepisternum; punctures on the latter similar to those on mesoscutum; metasoma without distinct punctures, only with sparse and small ones; smooth apical margins of three basal terga broad and distinct in the middle as in *speciosa*.

Head violet, shining, with brassy reflection; narrow lateral stripe of face, median stripe of face, which is interrupted on supraclypeal area and not extended above beyond the latter (thus, no stripe on frons between supraclypeal area and mid ocellus), narrow and rather short stripe on genal area along eye margin, and small mark on labrum, yellow. Thorax violet, shining, with or without slight brassy tint. Wings distinctly darkened, stigma, veins and tegula deep brown. Metasoma piceous with purple tint. Legs also piceous, with small pale yellow marks on bases of fore and mid tibiae.

Hairs white on head, thorax and basal portions of legs; long bristles on underside of hind basitarsi brown; metasomal terga without fringe of hairs; hairs on apical portion of metasoma black.

TYPE MATERIAL: Holotype female (No. 100) and a paratype female (No. 121), Sigi Camp, 1500 m, New Guinea, 14. II. 1939 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.



Figs. 28-29. *Palaeorhiza (Cnemidorrhiza) elegantissima* (Dalla Torre). 28: Frontal view of the female head. 29: Dorso-lateral view of the female head and thorax.

(19) *Palaeorhiza (Cnemidorrhiza) elegantissima* (Dalla Torre)

Palaeorhiza (Cnemidorrhiza) elegantissima: Hirashima, 1981, Esakia, (17) : 22. Redescription of female.

Two females of this species are examined from Misool. This is the first record of this species outside continental New Guinea.

SPECIMENS EXAMINED: 2 females, Fakal, Misool Is. (W.), 0-75 m, on small

fragrant flowers of shrub, 23. IX. 1948 (M. A. Lieftinck).

DISTRIBUTION : New Guinea and Misool.

(20) *Palaeorhiza (Cnemidorrhiza) speciosa* Hirashima

Palaeorhiza (Cnemidorrhiza) speciosa Hirashima, 1981, Esakia, (17) : 38, male. Papua New Guinea (Chimbu)

This species was described from the male. The female of this species from Ibèlè Camp, which is somewhat hesitatingly combined, is readily separable from **Patricia** Cheesman by the mesoscutum more shining and sparsely punctate and absence of dense tergal hair fringes, and from **cyanea** Hirashima by the presence of yellow markings on the mesoscutum, axilla, metanotum and sides of thorax. The pattern of yellow markings of the female is similar to that of the male.

The status of more important subgeneric characteristics is as follows: dorsal face of hind tibia coarsely sculptured except for extreme base only, as usual; tuft of fuscous hairs on apex of hind femora more or less well developed (but not conspicuous because of similar color of leg); caudal fimbria dense; and pygidial plate not distinct

Female: Length about 9 mm.

Relative head measurements : length, 31.5; width, 35; upper interocular distance, 19 ; width of face, 22 ; lower interocular distance, 17 ; eye length, 25; length of clypeus, 13.8, that of clypeus below line tangential to lower margins of eyes, about 5. Inner eye margins slightly more strongly converging below than in **cyanea**; malar space slightly less than half the basal width of mandible ; clypeus and supraclypeal area well convex like **cyanea**; upper swelling of the latter distinct, narrow. Mesoscutum shining, with more or less dense, well separated punctures about as strong as in **cyanea**; scutellum well convex; propodeal enclosure large, well convex, nearly smooth, shining; underside of thorax not coarsely sculptured as in **cyanea**. Metasoma well convex, with weaker punctures than in **Patricia** and **cyanea**.

Head and thorax dark steel blue, shining, with slight brassy tint; five

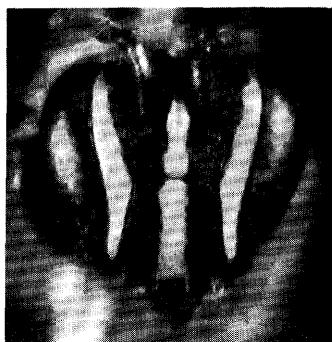


Fig. 30. *Palaeorhiza (Cnemidorrhiza) speciosa* Hirashima.
Frontal view of the female head.

stripes on head, a pair of small spots on labrum, band on pronotum, four stripes on mesoscutum, axilla, lateral stripe of scutellum, a pair of transverse marks on metanotum (these marks combined and forming a transverse band in one specimen), large mark on tubercle, three transverse marks on side of thorax below wing bases, and small mark near end of pre-episternal groove, yellow with blue tint; the median stripe of face rather broadly separated from mid ocellus ; tibiae of fore and mid legs with yellow-blue marks basally.

Hairs on head and thorax rather long (longer than in *patricia* and *cyanea*), white ; no darker hair on mesoscutum; white hair covering at sides of propodeum slightly longer than in *cyanea*; no tergal hair fringe but white hairs on apical margins of three basal terga slightly dense on lateral portions; caudal fimbria nearly black.

SPECIMENS EXAMINED: 5 females, Ibèlè Camp, 2200 m, 2. XII. 1938 (L. J. Toxopeus) .

DISTRIBUTION : New Guinea.

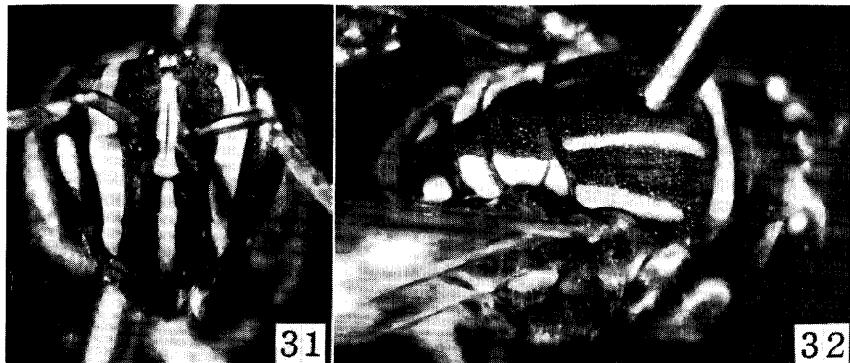
(21) ***Palaeorhiza (Cnemidorrhiza) decorata*, new species**

This is another beautiful species of *Palaeorhiza* which is, unfortunately, known from the type female only. This is easily recognizable by its ground coloration and the pattern of the yellow markings.

The status of more important subgeneric characteristics is as follows: caudal fimbria dense; pygidial plate not distinct; dorsal face of hind tibia more or less coarsely sculptured although basal portion of it broadened; and apical tuft of black hairs on hind femur conspicuous.

Female: Length about 7 mm ; fore wing about 6.5 mm long.

Relative head measurements : length, 28.5; width, 31; upper interocular distance, 17; width of face, 20.8; lower interocular distance, 17; eye length,



Figs. 31-32. ***Palaeorhiza (Cnemidorrhiza) decorata*, new species.** 31: Frontal view of the female head. 32: Dorso-lateral view of the female thorax. Note also the yellow markings on the propodeal enclosure.

22.5; length of clypeus, 12, that of clypeus below line tangential to lower margins of eyes, about 4.5. Inner eye margins only slightly converging below; malar space narrow; about half as long as basal width of mandible which is rather narrow; space between eye and clypeus broader than malar space; clypeus and supraclypeal area well convex, their outline arched as seen from side of head; upper portion of the latter slanting upward, neither highly nor angularly elevating, slightly dilated laterally, with a distinct median sulcus; frons slightly convex; ratio of width of posterior ocellus to postocellar distance to ocellocular distance to ocellooccipital distance as 2.5 : 3.0 : 4.5 : 4.8.

Frons with very small, dense punctures; mesoscutum with very dense, rather small punctures; punctuation of mesoscutum more or less similar to *elegantissima* but much closer than in *aemula* and *speciosa*; scutellum more coarsely punctate than mesoscutum; metanotum weakly, densely punctate; propodeal enclosure smaller than in *aemula* and *speciosa*, slightly more lineolate than in these two species but smoother than in *elegantissima*; underside of thorax not coarsely sculptured but slightly more granular than in *aemula* and *speciosa*. Metasomal terga smooth, shining, nearly impunctate.

Frons and upper portion of head blue-green; genal area less metallic, red-ferruginous except for upper portion which is dark metallic; clypeus, supraclypeal area, malar space and mandibles reddish brown; head with following markings orange yellow: long and broad stripes along anterior and posterior margins of eyes, median stripe of face (which is narrower, slightly interrupted between clypeus and supraclypeal area, and almost reaching the mid ocellus), mark on labrum, and basal marks on mandibles; malar space without yellow marking. Thorax blue-green, with purple reflection dorsally; posterior face of propodeal enclosure red-purple; thorax with following markings orange yellow: broad band on collar of pronotum, four stripes on mesoscutum (the median two slender and longer), mark on axilla, rather broad stripe on lateral portions of scutellum, transverse band on lateral portion of metanotum, a pair of rather large, round marks on propodeal enclosure, large mark on tubercle and interrupted band at side of thorax below wing bases. Wings brownish, with fuscous hairs distinctly shorter than in *aemula* and *speciosa*; veins and stigma brown; tegula brown, subhyaline. Legs reddish, with yellow markings on fore tibiae and bases of mid tibiae. Metasoma red with purple tint, shining; broad apical margins of two basal terga slightly darker and appearing grey-purple (with enamel-like lustre) in some light.

Not hairy; hairs on head scanty, whitish; hairs on mesoscutum slightly brownish in some light; hairs covering lateral and posterior faces of propodeum short, dense, white; metasomal terga entirely without fringe of hairs on apical margins; caudal fimbria blackish.

TYPE MATERIAL: Holotype female, Sigi Camp, 1500 m, 14. II. 1939 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(XII) Subgenus **Cercorhiza** Hirashima

Hirashima, 1982 b, p. 88.

Type-species : *Palaeorhiza gressittorum* Hirashima, 1975

The subgenus was proposed to include 11 species of *Palaeorhiza* of New Guinea and Solomon Islands. It is unique in having the basitibial plate on the hind leg, dense and often coarse hairs on the dorsal face of the hind tibia, and well defined pygidial plate associated with dense caudal fimbria on the 6th tergum. These characters, however, are associated with the female sex only.

In this paper we describe 4 new taxa of this subgenus.

KEY TO THE FEMALES OF *Cercorhiza* DESCRIBED IN THIS PAPER

1. Head black, with black hairs; more than 8 mm 2
- Head metallic (not brightly so but with delicate tint of purple, blue and copper); mesoscutum, scutellum, metanotum, propodeal enclosure, pre-episternum, upper half of mesepisternum and upper half of metepisternum dark red; the rest of thorax black with distinct metallic tint; wings strongly brownish; tegulae reddish brown; legs red; metasoma variable in color, but at least 1st segment and medio-basal portion of 2nd tergum red; the rest of metasomal terga blue-green; 2nd tergum smooth, shining, with small and dense punctures; 3rd tergum more finely and very densely punctate on finely shagreened ground, with very narrow apical impunctate margin; malar space very narrow anteriorly; length about 8 mm **angusta**, new species
2. Mesoscutum, scutellum, metanotum, propodeal enclosure, pre-episternum, mesepisternum and upper sclerite of metepisternum deep red (but underside of thorax often variably black in the middle longitudinally); the rest of thorax black * 3
- Thorax entirely black with black hairs; clypeus and supraclypeal area distinctly convex; clypeus rather strongly and coarsely punctate on lateral portions; mesoscutum very closely rugoso-punctate on minutely shagreened and dull ground, punctures very small; basitibial plate of hind leg well indicated, nearly smooth, shining; 3rd tergum with broad impunctate apical margin; wings strongly brownish; tegulae pale brown subhyaline; legs dark red; metasoma with 1st segment and 2nd tergum dark red, the rest of terga black with metallic tint **pullata**, new species
3. Two basal terga and 3 basal sterna deep red; 3rd tergum finely shagreened, with very dense and small punctures; upper interocular distance only slightly longer than lower interocular distance (22 : 21) **gressittorum rubicunda**, new subspecies
- Metasoma with basal segment and sometimes medio-basal portion of 2nd tergum only red; 3rd tergum slightly more shagreened with weaker (very small) and sparser punctures; upper interocular distance much longer than lower interocular distance (25 : 22) **simillima**, new species

(22) ***Palaeorhiza (Cercorhiza) gressittorum rubicunda*, new subspecies**

Palaeorhiza gressittorum Hirashima, 1975, J. Fac. Agr., Kyushu Univ., 20: 38, female and male. Papua New Guinea.

P. gressittorum Hirashima was described from the high mountains of Papua New Guinea. This is a soil nesting species whose morphological characters are adaptive to nest in the soil, as described by Hirashima in 1975.

The new subspecies may easily be separable from the nominate subspecies as follows: Basitibial plate of female hind leg smaller (like *simillima*, see below), 2 basal terga and 3 basal sterna red (1 basal segment only red in *g. gressittorum*), punctures on 2nd tergum sparser, a pair of longitudinal ridges on male 3rd sternum stronger, and male 4th sternum often distinctly and broadly elevated basally.



Fig. 33. *Palaeorhiza (Cercorhiza) gressittorum rubicunda*, new subspecies. Frontal view of the female head.

It seems probable that this new subspecies may be regarded as a good species when the *gressittorum* complex (*gressittorum* and *simillima* and may be more) is studied in detail.

Relative measurements of female head : width, 40.0; length, 35.0; upper interocular distance, 22.0; width of face, 26.0 ; lower interocular distance, 21.0 ; eye length, 27.0; length of clypeus, 15.0, that of clypeus below line tangential to lower margins of eyes, about 6.0; length of malar space, about or a little less than 3.0 anteriorly. Relative measurements of male head: width, 39.0 ; length, 35.5; upper interocular distance, 20.5; width of face, 24.0; lower interocular distance, 18.0; eye length, 27.0; length of clypeus, 16.5, that of clypeus below line tangential to lower margins of eyes, about 7.0; length of malar space, 4.0 in the middle.

TYPE MATERIAL : Holotype female, Moss Forest Camp, 2800 m, 16. X. 1938 (L. J. Toxopeus) ; 7 paratopotype females and 22 paratopotype males, X-XI. 1938 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(23) *Palaeorhiza (Cercorhiza) simillima*, new species

This is a very close relative of *P. gressittorum* Hirashima, but is separated as follows :

Female: Basitibial plate smaller with weaker lateral margins, face slightly broader and inner eye margins more converging below, upper interocular distance longer, 2nd tergum with sparser punctures, often reddened medially, and 3rd and following terga more granular (therefore duller) with weaker and much sparser punctures. Relative head measurements : width, 41.0 ; length, 35.0 ; upper interocular distance, 25.0; width of face, 27.5; lower interocular distance, 22.0; eye length, 26.5 ; length of clypeus, 15.0, that of clypeus below line tangential to lower margins of eyes, about 6.0; length of malar space, about or a little less than 3.0 anteriorly.

Male: Face dull (weakly shining in *gressittorum*), clypeus broader (especially on upper portion), more flat on upper portion, distance between clypeus and eye shorter, 2nd tergum with sparser and a little weaker punctures, 3rd and following terga more granular with weaker and sparser punctures like female, median yellow stripe on clypeus often shorter, and scape often all black. Relative head measurements : width, 38.8; length, 35.0; upper interocular distance, 22.0; width of face, 24.5 ; lower interocular distance, 17.5; eye length, 26.5; length of clypeus, 15.0, that of clypeus below line tangential to lower margins of eyes, about 7; length of malar space, 3.5 in the middle.

TYPE MATERIAL : Holotype female, 2 paratype females and 5 paratype males, Letterbox Camp, 3500 m, 16. VIII. 1938 (L. J. Toxopeus) ; 1 paratotype female, 31. VIII. 1938 (L. J. Toxopeus) ; 5 paratotype females, 3600 m, 13. IX. 1938 (L. J. Toxopeus) ; 1 paratotype female, 5. IX. 1939 (L. J. Toxopeus).

Note :

(1) One female and 3 males from the same place are parasitized by a strepsipteron. These are excluded from the type material, although no styllopization is observed.

(2) Twenty-six specimens (10 females and 16 males) from Lake Habbe-ma, 3250-3300 m, VII-VIII. 1938 (L. J. Toxopeus) are tentatively determined as *simillima*, although these are distinct in having very weak and rather dense punctures on the 2nd tergum in both sexes, and slightly shorter malar space in the male.

DISTRIBUTION: W. New Guinea.

(24) *Palaeorhiza (Cercorhiza) pullata*, new species

Unfortunately this is known from the type female only. This is a close relative of *P. melanosoma* Hirashima from Chimbu, Papua New Guinea, having a similar appearance of the head, but is separable from it as follows: Malar space a little longer anteriorly, face less shining, space between facial

fovea and top of eye with punctures indistinct (with distinct punctures in *melanosoma*), punctures on mesoscutum smaller and closer; punctures on mesepisternum much weaker, 1st tergum more shagreened and duller, 2nd tergum also more shagreened and more punctate, hairs on head and thorax more blackened, 2 basal metasomal terga dark red, and tegulae pale brown subhyaline (shining brown in *melanosoma*).

Female: Length about 8.5 mm.

Relative head measurements: width, 38.2; length, 33.0; upper interocular distance, 23.5; width of face, 26.0; lower interocular distance, 21.5; eye length, 24.5; length of clypeus, 14.0, that of clypeus below line tangential to lower margins of eyes, about 5.5; length of malar space, about 2.0 anteriorly. Space between clypeus and eye distinctly broader than malar space as in *melanosoma*; clypeus and supraclypeal area distinctly convex; the former with coarse, longitudinal punctures on lateral portions; ratio of postocellar width to postocellar distance to ocellocular distance to ocellooccipital distance as 2.9 : 3.7 : 7.0 : 4.0. Mesoscutum exceedingly densely punctate on shagreened and dull ground, punctures very small; scutellum with larger punctures on lateral portions and with minute and very close punctures on median portion longitudinally; propodeal enclosure microscopically shagreened or with microscopical punctures, weakly shining; mesepisternum roughened and punctures indistinct on upper portion; precoxal carina very weak. Basitibial plate of hind leg well indicated, nearly smooth and rather shining (similar to *melanosoma*); hind tibia with dense coarse hairs dorsally as usual for *Cercorrhiza*. Apical impunctate margin of 2nd tergum more or less broad but not sharply indicated, that of 3rd broad and distinctly indicated as in *melanosoma*, and that of 4th also broad.

Head and thorax deep black, with no pale marking. Wings strongly brownish; tegulae pale brown subhyaline. Legs dark red except for coxae and trochanters black. Metasoma black, more or less shining; 2 basal terga dark red, and 4 apical terga with metallic (steel blue plus purple) tint.

Hairs on head and thorax black, rather long and dense; hairs on propodeum brownish; hairs on legs mostly blackish, paler on tarsi; hairs on metasoma black; no hair fringe on metasomal terga.

TYPE MATERIAL: Holotype female, Lake Habbema, 3250-3300 m, VIII. 1938 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

(25) ***Palaeorhiza (Cercorrhiza) angusta*, new species**

The new species may belong to the *concorda* species-subgroup of the *concorda* species-group of *Cercorrhiza*. This is easily separable from *P. concorda* Cheesman and *P. dorsalis* Hirashima in having the thorax and metasoma broadly reddened. This is described by two females only.

Female: Length about 8 mm.

Relative head measurements : width, 36.0; length, 31.0; upper interocular distance, 19.0 ; width of face, 23.0; lower interocular distance, 17.0 ; eye length, 25.5; length of clypeus, 12.8, that of clypeus below line tangential to lower margins of eyes, about 4.0; length of malar space, 1.0 anteriorly. Appearance of head similar to *concorda*; malar space very narrow anteriorly, broadened posteriorly; clypeo-ocular distance short (but longer than malar space), slightly shorter than in *concorda* and *dorsalis*; supraclypeal area distinctly convex, more convex than clypeus as seen from the side of head; upper swelling of supraclypeal area broad, similar to *concorda* and *dorsalis*; frons well convex ; ratio of postocellar width to postocellar distance to ocellocular distance to ocelloccipital distance as 3.0 : 3.0 : 5.0 : 4.8; space behind ocelli strongly slanting posteriorly. Mesoscutum densely and rather coarsely punctate like *concorda*; propodeal enclosure large, slanting, slightly more shining than in *concorda*; mesepisternum minutely roughened with weak and dense punctures; precoxal carina long, strong. Wing venation similar to *concorda* and *dorsalis* (stigma large ; 2nd submarginal cell large with 1st abscissa of vein M long and about or more than twice as long as 3rd abscissa; vein M interstitial with nervulus). Metasoma well convex dorsally as seen from the side as in *concorda*; 1st tergum smooth, shining with weak, rather dense punctures; 2nd also smooth, with dense and small punctures which are weaker and closer than in *concorda* and *dorsalis*; 3rd tergum very densely punctate on minutely shagreened ground, punctures very small which are much weaker than in *concorda* and *dorsalis*; apical impunctate margins of 2nd and 3rd tergum very narrow but distinct. Basitibial plate of hind legs well indicated.

Head dull metallic (delicate in shade as in *concorda* and *dorsalis*); mesoscutum, scutellum, metanotum, propodeal enclosure, most part of pre-episternum, upper half of mesepisternum and upper half of metepisternum dark red; the rest of thorax black with metallic tint (a mixture of blue, purple and copper). Wings distinctly brownish ; tegulae reddish brown. Legs red, partly slightly yellowish. Metasoma blue-green with 1st segment and medio-basal portion of 2nd red.

Hairs on head and thorax brownish, but those on propodeum and underside of thorax greyish ; caudal fimbria black; no tergal hair fringe.

Variation of color:

The paratype female is more extensively red on the metasoma, as follows : 2nd tergum nearly all red except for apical margin slightly darkened and metallic ; 2nd and 3rd sterna all red; and 4th sternum broadly reddened.

TYPE MATERIAL : Holotype female and 1 paratype female, Ibèlè Camp, 2250 m, 15. XI. 1938 (L. J. Toxopeus).

DISTRIBUTION: W. New Guinea.

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